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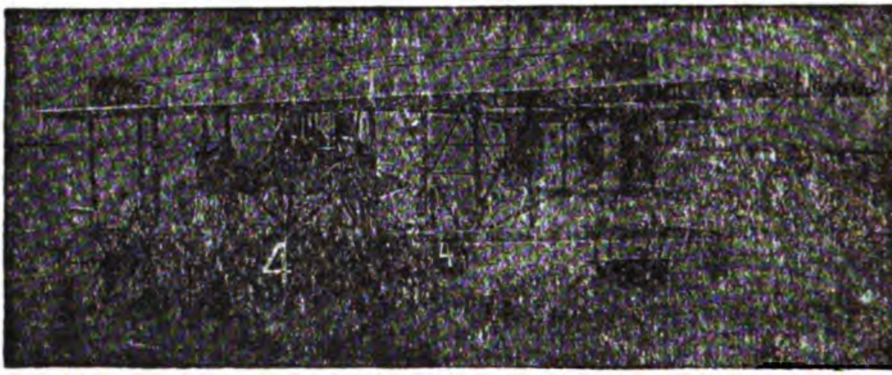

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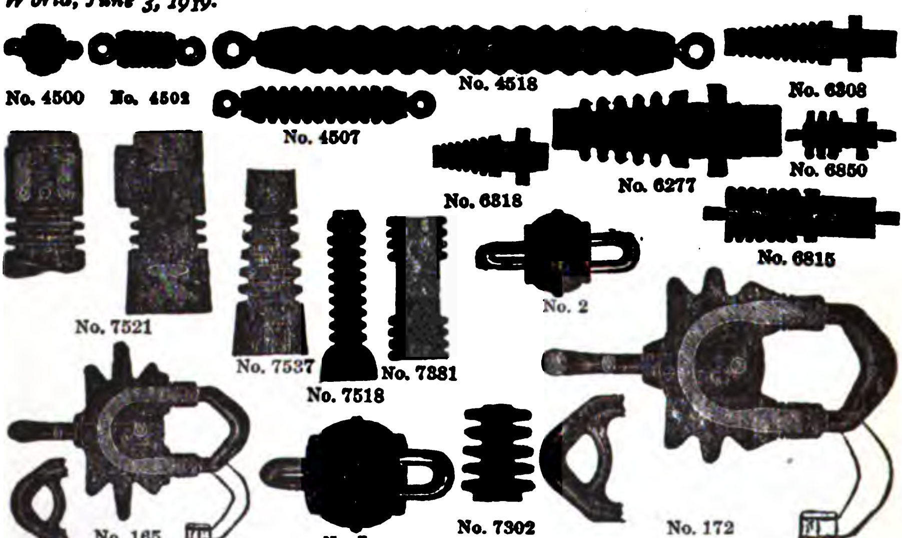
"By courier, coach and sail-boat, it took days for the news of Waterloo to reach London. During Lieut. Commander Read's flight to Halifax, Assistant Secretary Roosevelt in Washington sent a radio message to NC-4, of whose position in air he had no knowledge. In three minutes he had a reply."—*Extract from New York World, June 3, 1919.*



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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

INVENTION IN WAR

By Rear Admiral Bradley A. Fiske, U. S. Navy

It was not long ago that the inventor was looked at askance; and it was not until the advent of the great World War that the advisability of utilizing the inventor in war was recognized. Previously, officers had deprecated the idea of attributing much usefulness to him, fearing (and with some reason) that the country might trust too much to invention and neglect to make proper preparation. Now they see that the invention of the best kinds of weapons, methods and instruments should form an important part of the work of preparation.

Inventions, of course, are of numberless kinds and of numberless degrees of novelty, originality and scope. Some inventions, like the bow and arrow, the catapult, the gun, the steam-engine and the telephone, as well as the arts of weaving, writing and printing, were of the highest order in these respects; whereas some of the manifold improvements made on them from time to time have been improvements in such slight detail as hardly to be worthy to be called inventions.

Nevertheless, it can hardly be denied that, in order to produce any new and definite entity, that entity must be created. This does not mean that the materials of which it is composed must be created; for only the Infinite Creator can do that. A new thing may be created out of old materials. We are told by the Bible, for instance, that " the Lord God formed man of the dust of the ground."

Most of us carry the idea in our minds that an invention is a mechanical appliance of some kind. That this restricted idea of invention is wholly modern is indicated by Shakespere's exclamation, "Oh! for a muse that would ascend the highest heaven of invention." And all through literature we see constant indications of the idea that invention forms the basis of all great literary work.

In inventing, the first step is made by the imagination in forming a picture on the mental retina. Shakespere says:

> "The poet's eye in a fine frensy rolling
> Glances from Heaven to earth, and from earth to Heaven;
> And as imagination bodies forth
> The forms of things unknown, the poet's pen
> Turns them to shapes, and gives to airy nothing
> A local habitation and a name."

This suggests that in every invention there are three stages: conception, development and production. The analogy between this and the procedure in making the four steps in an estimate of the situation is not hard to see: for when we make a mental effort to picture to ourselves the mission which we wish to accomplish, we do what an inventor does when he pictures to himself with his imagination an invention which he wishes to produce; when we take account of the difficulties in the way and the facilities at our command for overcoming them and reach a decision as to a plan for accomplishing the mission, we do what an inventor does when he takes account of the difficulties in the way and the facilities at his command for overcoming them, and reaches a decision as to what facilities he will use and how he will use them; and when we finally produce a finished plan, we do what an inventor does when he finally produces his invention.

Of course, most plans that have been produced have not been of a high order of invention; but most instruments, poems, novels and schemes that have been produced have not been of a high order of invention. The declaration may be made with confidence, moreover, that invention of a high order has been shown as clearly and importantly in warfare as in any other of man's endeavors, and probably more so. In fact, the most important and original inventions ever made must have been the weapons with which men overcame wild beasts; for the simple reasons that they have been the basis of all subsequent inventions, and that it was because of

them that men were able to start on the upward path to civilization. Without those weapons, primeval man would have been unable to subdue the wild beasts that were stronger than he; and while he was building up a higher and higher civilization, he would have been unable to protect himself and his acquisitions against the savages and barbarians who tried sometimes to steal, and sometimes to destroy, the fruits of his endeavors.

If one follows the narrative of military history, he will see that civilized man was compelled to employ force against the force exerted by barbarians and savages, and that he prevailed by reason of the better weapons, appliances and systems of drill and tactics that he possessed. Now every one of those weapons, appliances and systems had been invented.

But it was not only by means of the things already invented that civilized man prevailed: it was because also of his inventiveness in emergencies. When we read the exciting story of Alexander's conquest of Asia and the still more exciting story of Cæsar's conquest of Gaul, we are continually given instances of how the barbarians, no matter how splendidly they made their first assault or their first defense, found themselves entirely at a loss when the time came for the next move; and that they were invariably thrown into a panic, if a sudden emergency arose and they found themselves confronted with disaster. Alexander, on the contrary (and in a higher degree Julius Cæsar), was never so superb as when such emergencies occurred. Each one of those men, when confronted with a situation that seemed hopeless and that would have been hopeless to other men, immediately invented a scheme that rescued victory from the very jaws of defeat. Each one of Alexander's battles was the carrying out of an invention. Cæsar's campaigns in Gaul were a series of inventions; witness for instance, his campaign against the superior forces of the Veneti mariners, which he won by cutting the halliards of their ships.

We see evidences of the same fruits of invention in Frederick's campaigns—and still more so in Napoleon's. What was the system that Frederick inherited from his father but an invention? What was Napoleon's beautifully neat scheme by which he drove the British out of Toulon but an invention? What was his first campaign in Italy but the carrying out of a plan which he had invented a year before and which the Directory had rejected? What else

was every other campaign of Napoleon's that so utterly bewildered his unimaginative enemies? What else was that superb plan of invading England with its alternative plan that culminated at Ulm and Austerlitz?

What else was Nelson's suddenly conceived and executed plan near Cape St. Vincent? What else caused Washington's crossing of the Delaware? What else caused Washington's sudden move to Yorktown?

Moltke's wars against Denmark, Austria and France in 1864, 1866 and 1870 may be put forward in rebuttal as wars directed, not by invention, but by plodding; directed by a laborious, unimaginative work of detail, carried on for many years. That there was much laborious and unimaginative work carried on for many years is doubtless true. But just that kind of work was carried on in perfecting the steam engine, the printing press and every other great invention; just that kind of work was carried on in developing every great idea in government, commerce and religion. As to literature, it is well known that Byron worked days and nights, sometimes, over a single line of poetry, and that Gray spent nearly his whole life in writing his "Elegy in a Country Churchyard."

The detail work of developing Moltke's idea into concrete plans of campaign was tremendous; but there was an idea existing before it was developed, and that idea was conceived by the imagination of Moltke. The idea was smaller in size than the "little grain of mustard seed" and of immeasurably less material weight; but it has been developed into a system that has spread over all the civilized world, and that will carry the name of Moltke in history long after Bismarck and William I have been forgotten.

Civilization was started by invention; its progress has been based on invention ever since, and it is based on invention now. The most important single agency in maintaining civilization has been war: for it was by war that wild beasts were subdued; it has been by war that the opposing forces of barbarism have been kept down, and it is by war that they must be continually kept down; otherwise, the forces of barbarism will prevail, as they did prevail for a time, when they destroyed the civilization of Rome.

Other agencies than invention and war have, of course, been at work as well; such agencies as religion, morality, industry,

study, etc., that bind civilized communities together, and enable them to act in concert. Yet in each one of these agencies, we see invention as the initiating force. For every religion, every system of morality, every branch of study had to be invented and produced, before it could exist.

If invention has been the initiating factor in the progress of civilization, by being the initiating factor in all the various agencies that have produced it, and if war has been the principal single agency in maintaining it, then *invention and war have been the most important constructive factors of history.*

That this fact has not been clearly recognized is true. The reason probably is that it is only within the last hundred years that invention has been recognized as an important factor in life, and that the material of warfare has grown so enormously in complexity and bulk, that the details have shut out our view of warfare as a whole.

Every man is confronted in his own life with the necessity for attending to details. Every officer in his own career is confronted continuously with that necessity, especially in his youth. Details must be attended to. The accuracy with which details are attended to makes the difference ofttimes between hitting the target and missing it—between failure and success.

Now there are two different kinds of mentality needed for grasping and handling general principles on the one hand and details on the other hand. Few men possess both kinds of mentality in any high degree: the man who seems to have shown the most capacity in both lines was Napoleon; with the possible exception of Julius Cæsar.

Some people become a little irritated when one speaks of these men, or of great geniuses in general, and declare that it is foolish to hold up such impossible examples for us to follow. The writer is willing to admit it is a little trying to one's self-esteem to note what such men accomplished, and that it sometimes has a depressing effect on one. But if it does have such an effect on any one of us, is not that a sign that his *ego* is getting a little too big, and that he had better take a primary course in humility? No one of us is expected to be a genius, every one of us knows that he is not a genius, and also knows that all his friends are distinctly aware of the fact. So why should we be disturbed if we cannot perform the feats of Cæsar?

But if we cannot perform his feats, we can modestly follow his line of effort. We can, for instance, try to master details to a sufficient degree to do the duties with which we are immediately charged, and try at the same time not to forget the general principles which we have been taught, and even to apply those principles whenever we see an opportunity to make some improvement.

Of course, the primary use of our efforts must be to keep in order and to operate the parts of the naval machine with which each of us is entrusted: for instance, a gun, a turret, a destroyer, or a ship, and to do this according to the instructions which have been given us. But if everybody did this and no more, we should never improve in any way, and the navy would never keep up with the progress of the world in mechanisms or in methods. If all the officers of the navy had done no more (many did no more) during the years between 1881 and 1920, we should now have only ships like the *Constellation* and *Hartford* to cruise in, the Bureau System would still dominate the Navy Department, and the War College would not exist. It was because Moltke did much more than this that the Prussian Army overwhelmed the Austrian and French almost with one blow, and that the name of Moltke is the last on the list of the super-great strategists of history.

While we toil on, therefore, doing our allotted tasks according to the orders that we receive, let us raise our eyes from time to time, and try to get a general view of what the Navy as a whole is trying to do, and see if there is not a chance to invent something that will help. This is what Moltke did; and this was why he was able so to utilize the possibilities of railroads and telegraphs, that he got his army into France before Bazaine and McMahon could unite, and whipped each one in turn.

AMERICAN SUBMARINE OPERATIONS IN THE WAR

(CONCLUDED)

By CARROLL STORRS ALDEN, PH. D.,
Professor of English, U. S. Naval Academy

PART II. OPERATIONS OF THE AMERICAN SUBMARINE PATROL (CONCLUDED)

3. THE PATROL OFF THE BRITISH ISLES

It was the seven L-boats of the Fifth Division, American Submarine Force, operating from Bantry Bay, Ireland, that had the actual war experience. Their personnel may not have been superior to that of the others, but they had the opportunity, so eagerly coveted, of operating in waters about the British Isles, where the Germans were constantly active. In their patrol of seven or eight months they made 21 contacts with the enemy.

To go back somewhat in our narrative, the *Bushnell,* one tug, and six of her brood of submarines—the *L-9* as narrated had put back to Boston—having reformed at the Azores, set out on 19 January, 1918, for Ireland. That very evening they ran into a gale which partially scattered the Division; and for several days it was another trying ordeal of heaving to, running at slow speed, again heaving to, losing towing hawsers, and getting under way again. After eight days the expedition, lacking two submarines, reached Queenstown. One of these, having become separated on the first day out, had returned according to instructions to Ponta Delgada. The other, the *L-10,* Lieutenant J. C. Van de Carr, U. S. N., losing touch with the Division, proceeded to the rendezvous appointed, and finding only thick weather with nothing in sight then laid her course to the ultimate destination, Berehaven, Bantry Bay.

During the voyage, Lieutenant F. J. Cunneen, U. S. N., of the *L-11* met with a painful accident. While he was standing on the bridge, a wave sweeping over caught him off his guard and dropped him on his back across the rail of the bridge. He was badly bruised, and for a while it was feared he had sustained serious internal injuries. Because of the gale, it was 36 hours before he could be transferred to the *Bushnell* for medical attention; and during all this time, the pain becoming unbearable whenever he attempted to lie down, he stood, holding on to a rod above his head. From the same ship, the chief machinist's mate had to be trans-

ferred to the tender for chlorine gas poisoning, and a seaman for infected finger. The *L-3* and the *L-10* each had the sad experience of losing a man overboard. The record of the latter is as follows:

From the War Diary of the L-10

24 January, 1918.—At 12.30 p. m., R. A. Leese, gunner's mate, 1st class, fell overboard and was lost before the boat could return to the spot. We were running on both engines at the time. He fell heavily, hitting the side of the boat, which probably stunned him. He may have been struck by the port screw. He was seen lying in the water motionless—the sea was moderate—but after we had turned and were heading for him he disappeared when we were about two boat lengths away. He wore rubber boots and heavy clothing. After circling the spot for one hour, I gave the order to proceed.

Next day Van de Carr reached Bantry Bay, and had the satisfaction of beating by two days the others, who put in to Queenstown.

25 January.—Arrived at rendezvous "A" at 7.00 a. m. Nothing in sight. Weather thick. Decided to proceed to Bantry Bay.

At 11.30 a. m. sighted land, which proved to be Black Ball Head, Bantry Bay. The land fall was rather remarkable, considering that for two days we had had no sight. Arrived off Berehaven at 4.00 p. m., and a trawler piloted us in and alongside the British submarine tender H. M. S. *Ambrose*. Reported to Captain Nasmith, R. N., Senior Officer Present Afloat, who cordially welcomed us and made us very comfortable. We reported the *L-10* ready for service.

Passed a German submarine on the way in.

The rest of the division spent a week and a half in Queenstown in refueling and making minor repairs. A common trouble, due to the pounding of heavy seas, was the buckling of torpedo shutters, and these had to be straightened. Then they went to Berehaven, where they found the *L-10* and two American destroyers, together with some British warships, including submarines. When on 21 February they were joined by the two boats that had started with them from Newport, but had turned back, Division Five was complete.

Repair work is never a thrilling tale, and the story of the *Bushnell*, like that of many another devoted mother, is lacking in adventure and brilliant achievement. Yet without the *Bushnell*, Division Five would have done little. There is an old rule in submarine work, that for every man afloat one is needed at the base. This is but an approximation; in order that 210 men on

the seven L-boats should plough the seas, fighting the Germans, 350 men on the tender toiled day after day and night after night, also fighting the Germans. Commonly, they worked in two shifts, 8.00 a. m. to 4.00 p. m. and 4.00 p. m. to 12.00 midnight; but when the necessity required it, they increased this to three shifts. Commander W. L. Friedell, U. S. N., who was in command of the submarine detachment during the latter part of their stay in Ireland, remarked that they repaired not only submarines, but everything in sight from a destroyer to a battleship. One day, the call came from the British fort nearby, on Bere Island; the

The Torpedo Tubes of the "AL-2" Being Overhauled by the "Bushnell."

armature of their pump had burned out. The officers there were in great consternation, for they had learned that it would take six weeks before they could get a new one. The *Bushnell* rewound it in three days. Lieutenant Commander H. M. Bemis, U. S. N., who, next in rank to Captain T. C. Hart as they began operations in British waters, had the immediate command of Division Five, showed great efficiency, not only with his own boats, but also on an English submarine. In the latter part of June he had joined H. M. S. *E-29* when she went out for her patrol in the North Sea. An epidemic of influenza striking them, the captain, first officer, and 17 men went on the sick list. The navigating officer, the only

one who did not succumb, was a reserve officer, detailed for navigating and communication duty only, and not at all trained in general submarine work. Thus it devolved upon Bemis to take command, and operate the boat with the remaining 10 men who were not sick. The embarrassment he may have felt in suddenly having the responsibility of a new and strange ship put upon him must have been heightened by the fact that most of the 10 men were obliged to man other than their regular stations, some of them being given duties they knew little or nothing about. When the engines were used, it was a continuous watch for all who were able to stand up. Bemis had thus to run things for two days, when the first officer recovered sufficiently to take some duties, though not so as to go on the bridge with exposure to the seas.

Admiral Sims had early insisted that there should be unity in command and that the British, who had so efficiently organized their own naval affairs, should continue to direct operations as the American force joined with them. This gave to the British the determination of the lines of patrol and the general plan of operations, but to the Americans almost complete independence in carrying out their part of the plan. On being requested, the British were prompt to lend assistance based on their full and varied experience. Immediately on the arrival in Bantry Bay of Division Five, Captain Nasmith, who had won promotion and highest honors because of his brilliant work in the Sea of Marmora and the Baltic, began the training of the American officers. Assisted by other British submarine officers, he began a series of lectures and conferences in anti-submarine tactics, and with this gave our boats daily practice in making approaches and firing torpedoes.

Bantry Bay, where this training was held, was admirably adapted to the purpose, being wide and having a uniform depth of about 20 fathoms with few rocks and shoals. Occasionally, enemy submarines would steal in to lay mines, but the indefatigable trawlers undid the mischief by sweeping the bay before each practice.

Supplementing their training, our officers went as observers on the British submarines as they made their regular eight-day patrols. It was thus, that a lieutenant attached to the *L-2* lost his life. The first and only definite news of the disaster was that furnished by an incoming freight steamer, who announced that

during the dark night preceding she had collided with a submarine. H. M. S. *H-5*, operating at that time from Bantry Bay, on board of which was Lieutenant E. W. F. Childs, U. S. N., never returned. His death had none of the spectacular appeal afforded by battle, but who would look upon it as less than the supreme sacrifice when a man gives his life to the service of his country?

The British had a vast amount of intelligence data relating to enemy submarines, which they placed at the disposal of our officers. They knew almost every time a boat left a German base, and often who was the commanding officer. Whenever the German vessels opened up with their radio, which they did with Teutonic regularity nearly every evening at the same hour, they would with a Teutonic lack of imagination disclose their position. The Allied radio stations along the Scotch, English, Irish, or French coasts would immediately note the peculiar German wave length, and by means of their direction finders determine the angle. Two or more stations comparing their data by telephone could at once establish the exact latitude and longitude of the sender. On various war maps at the British Admiralty and at American headquarters in London and Brest, the positions thus revealed would be plotted. Though the actual messages were in code, the call signal of various German submarines came to be recognized, and the name of the boat and her skipper furnished by the British Intelligence Department or by the rescued crews of merchant vessels that had been attacked was often correctly associated with the call. Thus it was not uncommon when a German submarine began talking that an American officer would remark, "There's Hans Rose opening up," mentioning by name whoever it happened to be. This information, supplemented by the constant reports of Allied or neutral merchant ships, submarines, and trawlers—observing as well as attacked—further enabled them to determine what course the Germans were following in going to and from their billets, the number of days each staid out, and the characteristic activities of each; *e. g.*, certain ones used only torpedoes, others preferred to sink ships by gun fire and bombs, and others laid mines. Finally, after an encounter reported by one of the Allied ships in the latitude and longitude where the Hun was known to have been, when the U-boat which had been talking so regularly became forever silent, they accepted this as almost positive evidence of her destruction.

It had been discovered that most of the enemy submarines at this time operating about the British Isles proceeded to their stations by running north about Scotland and then south on the surface, some at once entering the Irish Sea, and others following the west coast of Ireland, where they were within easy striking distance of the shipping not only such as converged towards southern Ireland, but also that in the southern entrance of the Irish Sea and the western entrance to the English Channel. The British submarines patrolled the North Sea, the northern part of the Irish Sea, the English Channel, and the west coast of France. To the American force they assigned the waters off southwest Ireland, St. Georges's Channel, and Bristol Channel. Of the American billets, Commander R. C. Grady, U. S. N., who during the latter part of the war commanded Division Five, writes:

> Patrol lines were laid out on the chart in the most likely locations and designated by letters. These lines were usually about 30 miles long and located from inshore. Three days before beginning a patrol, the Detachment Commander would propose by telegraph to the Commander-in-Chief, Coast of Ireland (Admiral Lewis Bayly, R. N.), sending three submarines to three of the lines. This proposal was based on intelligence reports of the locations of the enemy, and probable intentions of the enemy. The proposal was usually approved and notice sent to all concerned that certain submarines would operate on these lines. The intent of this was to let destroyers and patrols understand that a submarine sighted in the designated vicinities was possibly friendly.

On 6 March the brief period of special training for the American submarines ended as two of them went to their billets for an eight-day patrol. Shortly after this to the end of the war. the Division maintained its patrol with almost absolute regularity. three boats out for eight days, and four boats in the harbor. The run to and from their stations was usually made on the surface. During most of the day when on patrol, they ran submerged; at night they steamed at slow speed on the surface, ventilating and recharging their batteries. The eight-day system was excellent in its provision for regular duty and rest, and at all times allowed one of the boats a double period in port for the personnel to recuperate and the boat to be overhauled.

Since the British already had their L-boats, the American submarines were hereafter designated AL-boats.

Contact Made by the U. S. S. AL-1

It was during his first patrol that Lieutenant (J. G.) G. A. Rood. U. S. N., commanding the *AL-1,* had his best adventure. On 22 May, 1918, when running close to the Scilly Isles (Lat. 50-30. Long. 6-33-30), he sighted near noon a German submarine on the surface in light condition. Immediately submerging he made for her, but in the maneuvering she outdistanced him and disappeared. Then Rood submerged and, using his listening tubes, followed the sound. At 2.40 p. m., or 1440 as our officers had come to say, following the European system of 24 hours, he again sighted a German submarine, this time 5000 yards distant, dead ahead. The *AL-1* had the advantage of a superior periscope. the best there was in Division Five, and of British make. Submerging again, and as he came up at intervals showing only the smallest amount of periscope, he approached to within 600 yards of the enemy, meanwhile flooding all torpedo tubes. The Hun was exposing a full broadside and evidently scented no danger, for men could be seen moving about her decks, some of them smoking. At this point the *AL-1* fired two torpedoes, one aimed at the enemy's bow and the other at her conning tower. She was in an admirable position for making a good shot. And Rood, conscious of his deliberate and accurate aim, remarked as he pressed the firing button, " Save a dinner for Captain Smaltz." But the *AL-1,* this being her first patrol, had not guarded against the sudden change of trim when two torpedoes, each weighing approximately a ton, were discharged. The bow rose, and Captain Smaltz, or whoever it was that had been invited to dinner, took alarm.

There was instant response by the Huns. A dense black smoke shot out from their port exhaust, which had previously been clear, and they evidently backed on the starboard motor. This swung their stern towards the attacking boat, and enabled them to avoid the torpedoes, which made straight runs and probably passed within a very few yards of their bow. Then the enemy opened on the *AL-1* with their stern gun, firing four or five shells wide of the mark. The *AL-1* later fired two more torpedoes, but the fleeing enemy easily dodged them. Rood then attempted to track the enemy, and not until night did he give up the pursuit.

Contact Made by the U. S. S. AL-11

Within a few miles of the same spot, Lieutenant (J. G.) A. C. Bennett, U. S. N., commanding the *AL-11*, made his try for an enemy submarine. The following is the record of his War Diary:

11 May, 1918. Lat. 50-32. Long. 6-39.—At 1510 while on course 270° sighted enemy submarine, bearing 260°, distant about 6000 yards. Changed course to 350° to intercept him and went ahead on both motors, parallel, 300 amperes on a side. Ran at 20 feet, dipping under between observations. Flooded all tubes for attack. Estimated enemy's course to be 60°, 10 knots speed. Closed to 900 or 1000 yards, then swung to firing course for 100° track angle. Fired two torpedoes at 1532, at intervals of five seconds, periscope angle, 15°. One torpedo was seen to broach. The other torpedo began straight hot run, but war head exploded at distance of 500 yards from this boat and 200 yards short of enemy's track. Enemy dived when torpedo exploded. It is believed that our approach was unobserved.

The U. S. S. AL-10 Depth Bombed

The eight days in port between patrols gave the officers chance for conferences in which they studied the latest information in regard to the operations of the enemy. On the day of leaving they commonly had something of practice in making an approach on a submarine, one of their number acting as target. Before departing for their billets, the submarines were given a memorandum of the outgoing and incoming convoys, their course and speed, so that they might study to avoid their paths—especially at night, when the submarines would be running on the surface, and like the convoys without lights. Also they were furnished with the latest calls and orders, and a list of day and night recognition signals. As on the American coast, the greatest danger was from friendly craft. Of this Lieutenant J. C. Van de Carr, U. S. N., commanding the *AL-10*, received some vivid impressions.

The incident occurred on 25 March, which was probably on his second patrol. At 5 o'clock in the evening, while running on a northerly course on the surface, he espied in the distance a vessel which he took to be a German submarine. For some time there was the usual doubt and questioning, for though conning tower and high radio masts could be distinctly made out, the color was of an unusual gray. Visibility was not the best, and it was only when the two had been approaching each other for some minutes that Van de Carr realized that his enemy submarine was a destroyer. Then confident that he had not been seen, he gave the

order for a quick dive and went down to 100 feet. In his haste he had taken in a little too much water, giving a slightly negative buoyancy. To overcome this he gave orders to blow out a few hundred pounds and to run the bilge pump for some seconds. On came the destroyer, and the men of the *AL-10* could hear the propeller blades churning almost directly overhead. A moment later there was a rumble and crash, accompanied by a shock that suggested an earthquake at sea. Then they found themselves in total darkness. The destroyer, scenting their presence, from an oil slick left on their submerging or produced by the working of the

Getting Her Trim. The U. S. S. "AL-10" Submerging in Bantry Bay.

bilge pump, had dropped a depth charge. In the submarine, though the lights had been put out, and the men partially stunned, when they turned on the emergency lights they found that no damage had been done. What disturbed Van de Carr most was that he could hear the destroyer stop and listen, and then go ahead full speed, and then repeat the game. In consequence he deemed it prudent to change his course 90° and put on full speed. The *AL-10* was in a dangerous locality. This her complement sharply realized again when a second time they were knocked down by the explosion of a 300-pound depth charge. It had now become apparent that their friend above was likely to waste a good many depth charges before he satisfied himself that he had done his full duty, and the crew

of the submarine became more and more unhappy. To meet the crisis, the commanding officer gave orders to blow the main ballast tanks, and set the diving rudders for a rapid ascent to the surface. This was a dangerous thing to do, and nothing but their extreme hazard would have warranted it. Some seconds must elapse between the time when a periscope first breaks water and that when the submarine is actually on the surface and can be recognized. During that interval the swift destroyer, in close proximity, may ram the submarine, or sink her by gun fire. To make this period of greatest peril as short as possible, Van de Carr had an officer and a man enter the conning tower with him so that at the instant this emerged they could throw back the hatch and jumping out on the bridge give the day signal (a smoke bomb that on exploding opened up a colored parachute), and at the same time also give the blinker signal.

The plan worked well. In fact as they sprang out on the bridge, they discovered that the destroyer was 1000 yards distant, and they were not seen until they displayed the recognition signals.

If Van de Carr had something of an injured feeling in having been jostled rather unceremoniously, he swallowed it later in the course of a sumptuous dinner given by the captain of the destroyer. For by one of the strange meetings that fortune so cunningly devises, not only was the destroyer an American, but her commanding officer was Van de Carr's classmate at the Naval Academy, in truth his roommate, Jack Simpson, whom he had not seen since leaving Annapolis.

The Care Taken of the Personnel

Rarely have any captains given more thought and individual attention to the welfare of their men than did the young skippers on the submarines. There were two reasons for this. The three officers and 27 to 30 men, being constantly thrown together for days and weeks at a time in most intimate relations, developed a kind of family life, and when anyone was sick or in trouble it was soon known by the others. Further, the officers quickly noticed the physical effects of long patrols, and knew that if they were going to maintain the efficiency of their commands they must look to the welfare of their crews. Thus they studied them like a trainer developing a football team.

In peace times submarine service had not been particularly wearing. With only occasional dives, and those of short duration, the personnel, which had quarters in barracks or on a tender, had not found their living conditions essentially different from those of other branches of the Navy. But in the long patrols during war the men quickly fell off. The commanding officer of the *N-5*, operating south of Long Island, spoke of the service as being "a great weight reducer;" in two patrols he went down from 190 to 170 pounds. Corresponding to the very long summer days of the northern latitudes in European waters, the period of submergence for the submarines was protracted. The first effect was that the men breathing the vitiated air felt listless, complained of a slight headache, and showed a lack of appetite. The smoking privilege was not taken away, but a cigar or a cigarette would burn dully like a piece of rope and if not given constant attention went out; further, it was likely to make the smoker sick. The latter experience followed also if a smoker lighted up previous to two or three hours after a long submergence. It required most men fully that time before they felt normal.

As the men engaged for a longer period in this service, there developed troubles that were more lasting, such as rheumatism, nervous affections, and indigestion. These were largely due to lack of exercise and to confinement in the cold submarine, where the humidity was so great that moisture would annoy a man by dropping into his soup as he sat down to supper, or on his face as he turned in off watch. To lessen the ill effects officers gave close attention to diet. The ordinary man would eat all put before him, and was inclined during the comparatively inactive life to eat too much; this he would do until his appetite had failed, when something was so decidedly wrong that his cheerfulness went and his efficiency was impaired.

As Lieutenant Commander English remarked, "The secret of keeping the men well is to make the food attractive and to leave them just a bit hungry." This officer prepared a series of menus providing for a five-day cycle, which was really a triumph of achievement with canned goods and an electric range.

The first few days out from port they relied on fresh fruit, vegetables, and meat taken with them. But little beyond potatoes and onions would keep more than five days, and most of it considerably less. Even bread wrapped in wax paper became mouldy

after two or three days. Coffee appeared only once each day on the menu. Experience showed that where the coffee pot was regularly kept on the range, men would go and help themselves at all hours of the day or night, particularly at the time when they were about to go on duty or had just come off. Lieutenant A. C. Bennett notes in his War Diary, " Coffee stimulates and then reacts much as alcohol would do." And he recommended that cocoa. which was then not included in their rations, should be issued to submarine crews in the proportion " of three parts of cocoa to one of coffee." Others said much the same, and took measures for guarding the men from becoming what they called " coffee addicts."

Lieutenant Commander J. C. Van de Carr, U. S. N., who during the latter part of the war commanded the Fourth Division, Submarine Force, made the following observations in regard to diet, gained from his experience on the *AL-10:*

Coffee for breakfast only.

Cocoa for dinner.

Tea for supper.

Cocoa for night watches.

Good soup for dinner or supper—once each day. A bowl of good soup is often all a man wants at sea or submerged.

Macaroni and cheese constituted one meal every second or third day.

Meat was served sparingly, and vienna sausages not at all.

A barrel of pickles was kept on tap.

Fruit of some kind for breakfast—usually prunes or an orange.

A dessert was provided once a day, usually canned peaches, pears, pineapples, apple pie, or rice pudding.

Canned tomatoes are very popular. Boiled rice often replaced potatoes.

A committee of enlisted men made out the menu, largely, and it was very popular.

Very little meat is needed on a submarine, and it runs into money quickly. By cutting down meat, more soup, vegetables, fruits, and milk can be served. Canned milk is an important item and should be used freely. On the menu outlined, the expense was about 60 cents a day, and there was little constipation.

A great deal of meat is wasted and thrown overboard. If only enough is prepared to give each man on the boat half a ration, it will be found to be about right. The meat should be supplemented with two vegetables, potatoes (or rice) and peas (or string beans, corn, tomatoes, etc.) in small rations.

Baked beans should be a meal in itself.

Jam or preserves should be served once a day.

Eggs should be served for breakfast about twice a week, *if fresh*. If not strictly fresh, they are wasted and better not be included in the menu.
Pie, etc., can be made on the tender and served during the first two days.
Pancakes make a very good breakfast about twice a week.

Another wise measure adopted to relieve the personnel mentally as well as physically from the wear and fatigue inevitable in war service was to grant one or two officers and half the crew, on their return from every second eight-day patrol, a leave of absence beginning the moment they reached the tender and extending to the day previous to their departure on the next patrol. This

DIVISION FIVE WITH THE U. S. S. "BUSHNELL," BANTRY BAY.

enabled everyone during the course of two months to have a full week of liberty. Several made trips to London or Edinburgh for rest and recreation. It relieved the monotony of the patrols, and was following the principle emphasized by the army—that to get the best service from soldiers they should be kept at the front for only limited periods, and at frequent intervals be moved back to villages entirely outside of the atmosphere of war, with occasional trips to Paris or London.

Contact with the Enemy by the U. S. S. AL-4. Her Narrow Escape

The *AL-4* and the *AL-2* were the two lucky American submarines; for each had a record of making five contacts with the

enemy, and combined they got on the track of the Huns only one less time than all the rest of our submarine navy put together. In these they succeeded in giving the enemy several bad scares, and in one case something more.

The two adventures referred to in the sub-heading belong to separate patrols of the *AL-4*, nearly a month apart. Of the first Lieutenant Garnet Hulings, U. S. N., who was the officer principally concerned, later remarked, "This was the most thrilling moment of my life, and I never expect to have another like it." It occurred about dawn, 24 April, and was all over in four or five minutes.

The *AL-4* was on her way to her patrol station, and was running, as she had been through the bright moonlight night, on the surface. At five o'clock, when the moon was setting and there appeared the first signs of morning, she was approximately 125 miles north of the Scilly Isles, in the strategic position commanding the entrance to both St. George's Channel and Bristol Channel (Lat. 51-40 N.; Long. 6-50 W.). As she was about to submerge, the lookout reported a dark object in the smooth sea, one point off the port bow. A minute later (5.13 a. m.) Lieutenant Hulings, who was the officer on watch, from his station on the bridge made it out to be a submarine heading towards them, 1000 yards distant.

Hulings at once gave the order, "Get tubes ready for firing," and he stood by the helmsman, coaching him on.

Although the enemy had little way on, the two crafts neared each other so rapidly that Hulings was doubtful whether his crew would have a torpedo ready in time, and he planned to ram.

Two minutes later, the enemy had evidently sighted the *AL-4*, for she changed her course to starboard, exposing her port side, and began diving.

Hulings had in an instant followed her change of course by swinging his rudder to left, and as he saw her settling so that only her conning tower was visible, distant 200 yards, he fired the only torpedo that was ready, in the lower left tube, aiming at a point just forward of her conning tower.

The torpedo jumped ten yards to the left on leaving the tube, and then straightened out, making a straight hot shot. The wake passed just forward of the conning tower, probably under the enemy.

As no other tubes were yet available, Hulings then held to his original plan, and crowding on all speed attempted to ram her. But since by this time the enemy had entirely submerged, the *AL-4* passed through nothing but bubbles, though so near that they could hear the roaring of air from the ballast tanks. They then themselves dived and followed Fritz by their listening devices. They thus tracked him for a half hour before they lost touch.

Two hours later that morning, they sighted the masts and stacks of a convoy six miles distant, and shortly afterwards an enemy submarine, 3000 or 4000 yards from them in the opposite direction. Diving immediately to 30 feet, they ran for several minutes in the direction of their foe. Then reducing their speed, they rose cautiously for periscope observation. No Hun was in sight, nor appeared in that vicinity again that day. It seemed probable that the enemy were intending to attack the convoy, but were scared away by the "Yankee sub."

A peril much more nerve racking, in which the enemy had no part, was one that the *AL-4* passed through on 18 May.

She was at the time 30 miles from Small's Lighthouse on the west coast of England, and according to the usual program of the morning patrol she had been running for some hours 30 or 35 feet beneath the surface conducting a listening patrol. The commanding officer, Lieutenant Lewis Hancock, jr., U. S. N., who had been on watch during the latter part of the night, was getting some rest, and the next in rank, Lieutenant K. R. R. Wallace, U. S. N., had for two days been turned in, sick with "flu." This left Lieutenant Hulings as officer of the deck.

The sea being smooth, the depth was easily controlled; but the officer of the deck noticed that when they stopped to listen the boat would settle, indicating a slight unbalance and negative buoyancy. Whereupon he went through the procedure of adjusting the trim.

"Blow 300 pounds from adjusting overboard," he ordered, and knowing that there was a green hand at the adjusting pump valve manifold he stationed himself beside the gauge to see that he blew out only the amount directed.

The man repeated the order, but putting his hand on the wrong valve, opened not the adjusting but the auxiliary kingston. Hulings, looking at the adjusting tank gauge, saw no change,

and as he knocked it with his hand it did not move. Meanwhile no one noticed that they were taking in more ballast.

The officer of the deck then stepped to the air manifold to see what was the air pressure. That was all right, but it still did not affect the adjusting. As the boat was continuing to settle, he thought by speeding up to regain control.

"Batteries in series," was the order. And not having over much confidence in the electrician, who was another inexperienced man, the officer stepped into the engine compartment to supervise the shift from "parallel to series," and ended by making the shift himself.

"She's settling fast," called the man in charge of the diving rudders, and his tone told unmistakably that in the settling there was something wrong.

Hulings sprang back to the operating compartment, and saw the depth gauge whizz past 100 feet. He now gave orders to go ahead full speed, hoping by the diving rudders to check the descent. But this seemed to send her down all the faster, and before anything could be done to stop her she struck bottom at 294 feet. Heavy with 1900 pounds of negative buoyancy, she had buried her nose in the soft mud.

"Stop both motors and secure everything," was the instant order, and Hulings went to notify the commanding officer. But Hancock had heard the motors speeding up and felt the boat strike bottom. Not waiting to be called, he had come to take charge. A minute later, Wallace, who because of influenza, attended by high fever, had not been out of his bunk since leaving port, appeared.

Hancock had a short conference with his officers. At 100 feet more than their safe depth, half buried in the mud, they were admittedly in a dangerous situation. But all was calmness on the part of officers and men. Some of the latter off watch had been awakened by water coming in around the three-inch gun, but others were still asleep.

Putting their best men on the diving stations, they tried the safest measures first. They thought to bale the water out of the big tanks by transferring it from the auxiliary to the adjusting tank and then blowing it overboard. The adjusting tank was unusually strong and had been designed for emergencies. This expedient they tried two or three times, but without success.

They filled the tanks, but they could not overcome the greater pressure outside so as to blow them.

As now there came reports of leaking at various points, one officer was directed to go forward and aft and constantly make inspections. He found that especially in the engine room the boat was leaking noticeably around the rivets, phlanges, seams, sea valves, and stern glands (through which the propeller shafts run). The hatches were also leaking slightly.

Since the attempt to blow the adjusting tank was only increasing the pressure of air in the boat, this was stopped. They then tried to release the air by running the air compressors, but again they failed because of the excessive sea pressure. So the compressors were secured.

At this point, as the man at the bow rudders tried them, he discovered they could not be moved, for they were buried in the mud. There was the possibility that the boat might be broken out by going ahead or backing on their motors. This they tried next. They went ahead, 600 amperes on a side (series on each motor). Then they backed full speed. They tried going ahead with rudder hard right and then hard left—every eye glued on the gauges, except those watching the gyro compass. She would move about 5°, but no more. They tried alternately backing full speed on both motors, and backing one while going ahead with the other. Discovering that they were using up electric power and making no progress they desisted. Meanwhile the main pumps had been put on the duct keel for pumping out the main ballast. They pushed out perhaps a few pounds of water, but it was evident the pumps were feeble against the enormous sea pressure.

Again it was decided to try the motors, and at the same time to blow the bow ballast tank. As this tank was designed to withstand 90 pounds, they thought to apply only enough air to overcome the sea pressure, so as to put no more strain on it than necessary. When they attempted this, the air manifold relief valve blew off at 110 pounds. Whereupon they plugged the valve, and tried again, going ahead on both motors, 1200 amperes on a side.

"By Jove, I believe she moved," shouted one of the anxious watchers, who had his eyes fastened on the bubble that showed her balance.

A big argument followed as to whether she had, but the discussion was rather academic; for they were still in the mud on

the bottom, and their situation was growing desperate. They had been lavish in the use of air and electricity, and the steady leaking was fast becoming a menace. The water had mounted to within four inches of the main motors. Whatever was to be done must be done quickly.

They had tried the adjusting pump on the adjusting tank without success. Again they had to return to the expedient of blowing the bow ballast tank, and this time they decided that their critical situation warranted their going beyond the limits of caution and applying sufficient pressure, no matter how great might be required to blow the tank. But could the tank stand the strain? On this their lives depended.

At this point some one hit on a simple but effective means of changing the balance of the boat, by moving the living cargo aft. There were four officers and 26 men in her complement. All except the very few required forward for the next attempt were crowded back in the shaft alley. This required the waking up of some men forward, heavy with sleep because of duty through the night. There was a look of consternation on their faces as they were told why they had been aroused, yet everybody was calm. When all was ready they applied air pressure to the bow ballast, pushing it higher and higher, till instead of the safe 90 they had it at 140 pounds. At the same time they crowded speed on the motors. The boat had been resting at an angle of 2½° up. The bubble moved and the bow rose a little, but only a very little, for she was still in the mud, and even when the angle had changed to 5° she seemed loathe to leave the bottom. However, at 6° she broke loose and started for the surface.

As now she was coming up at a steep angle, the water in the forward part of the engine room went rushing aft, where the men were. At this, thinking that disaster had finally overtaken them, they yelled out, "Stern glands have carried away!"

Hancock, hearing the report, ordered the electrician to put all the remaining force on the motors. This inclining the boat still more, brought her to an angle of approximately 50°, which was so steep that when the men in the extreme end of the engine room tried to crawl forward they slipped miserably back in a heap.

When she had risen to 100 feet, Hancock gave orders to open the middle ballast kingstons for blowing. But the pressure built up in

the tank was so great that it jerked the starboard valve open and broke one of the side blocks.

As they reached the surface and opened the hatches to let in the blessed air and sunshine, the *AL-4* was a grateful and happy ship. For an hour and ten minutes she had been on the bottom at a depth, according to their gauge, of 294 feet, which closely agreed with the figures on the chart, 300 feet.

It had been a testing of the submarine in every way. The middle and after main ballast tanks, which had been designed to stand a pressure of 75 pounds, had been subjected to 127 pounds, without their leaking a drop into the battery tanks. And the forward trimming tank, built to resist a pressure of 90 pounds, had not suffered from 140 pounds. Best of all, officers and men, although conscious of how serious was their situation, had given not the slightest evidence of panic or excitement. Of this Hancock noted in his War Diary, "Every man stood by his station in as calm and efficient a way as if an ordinary drill were being conducted." Lieutenant Wallace, who at the beginning of the day had been regarded as a thoroughly sick man, announced that he was cured; and apparently he was, for he did not go back to bed again or suffer any relapse.

The Success of the U. S. S. AL-2

An attack of influenza while on patrol was also the lot of the *AL-2,* which seems to have had an unusually full share of varied submarine experiences. It developed on one of the regular eight-day patrols, the second day out, and 13 out of her complement of 25 were afflicted. The commanding officer, however, had the satisfaction of reporting on his return that they had carried on their patrol just as usual. Only one man when they got back had to be sent to the hospital. As one considers how severe was the epidemic, and how long it took most men to recover their full strength, this shows the stamina of our submarine navy.

A suggestion of how continuously, during the duty at Bantry Bay and earlier, the force kept going in the boats that had been so freely criticized before the war is to be found in the record of the *AL-2*. In the period between 1 December, 1917, and 1 November, 1918, she spent 125.4 days at sea, 83 of them on patrol. During this time she cruised 17,562.3 miles on the surface, and 1879 miles submerged (1163.1 hours submerged). Her commanding officer,

as she left Newport was Lieutenant G. A. Logan, U. S. N.; he was relieved on 19 May, 1918, by Lieutenant Paul F. Foster, U. S. N.

The perplexities incident to the chase of German submarines are vividly suggested by an incident of Foster's first patrol related in the War Diary of the *AL-2* as follows:

26 May, 1918.—En route to patrol billet QB. At 0700, while on course 90° (t.), speed 11.5 knots, Lat. 50-54 N., Long. 6-45 W., sighted ship resembling enemy submarine on surface bearing 360° (t.), distant about six miles. Headed for ship and identified it as an enemy submarine and observed that its course was about 300°. Submerged at 0730 and made approach, but was unable to hear anything on C-tube or to pick up enemy on periscopes. So came to surface at 0905 and found nothing was in sight.

Proceeded to billet, reaching western end at 1330. At 1542 sighted object resembling conning tower about three miles to eastward, and submerged and made approach on it. Sighted it once through periscopes, and found it was bearing 115° (t.), distant about 4000 yards, heading nearly southwest. It could not be positively identified and attack was continued, but ship was not seen again although it was heard faintly on C-tubes bearing 180° (t.) and was thought to be a submarine. As a good periscope depth was maintained and light conditions favored us, it was not thought that we were seen.

At 1645 came to surface to search horizon with binoculars and discovered two merchant ships steaming northwest in column, distant about three miles and bearing northeast from us. It was decided that we must have been seen, consequently we hoisted our colors and headed around under the stern of the column until the latitude of our billet had been reached, and then continued east (t.). At 1850 in Lat. 50-59 N., Long. 4-55 W., while steaming east (t.) at eight knots, sighted ship on the horizon dead ahead. It appeared to be a submarine, heading west southwest. Submerged immediately, and making approach picked it up through periscope at 1915. All officers, as well as three chief petty officers and several men, were of the opinion that it was an enemy submarine. But on account of the low power of periscopes and faulty tactics in the approach, we let the ship pass us and were about 4000 yards on its quarter when we again picked it up. Increased speed to eight knots and gradually drew up on the target. At 2030, when we were about 3000 yards away, what were thought to be the forward radio mast, or the net cutter, and a gun forward of the conning tower were made out. Continued on a converging course at eight knots, slowing before exposing periscope and stopping occasionally to listen in on C-tube and oscillator, but hearing nothing. As we got within good torpedo range and in a favorable position, we came to the firing course several times, and only refrained from firing because the target could not be positively identified, although it did present all the features of an enemy submarine. Everyone who saw it through the periscopes believed it to be such. When speed had been increased and distance reduced to 2000 yards, a small rectangular sail could be made out; but as this is a disguise frequently used by the enemy, it could not be taken as

proof of identity, and pursuit was continued until it became too dark to distinguish any characteristics of the target at 1500 yards.

At 2000 came quickly to surface and headed for target, and positively identified it as a trawler with a short mast forward, a derrick amidships, a small deck house nearer the stern, and a small rectangular sail on a very short mast abaft the deck house. Even at a range of less than 1000 yards its silhouette was strikingly similar to that of an enemy submarine. . . . The incidents of this day emphasized the serious shortcomings of low power periscopes.

One of the officers relates that the men, straining at the leash in their desire to get at the enemy, finally showed their impatience at all the fuss made by the new commanding officer in regard to identity: "Go ahead and shoot any way, Captain, and if it isn't a German submarine we'll never tell on you." As the officer laughing at the recollection added, "The possibility of killing a dozen limeys didn't at the moment trouble them in the least."

That evening, while returning from the chase, as they were running on the surface in the path of the moon, they came upon two trawlers on their starboard bow, and as they turned to avoid them they ran into three others that suddenly seemed to jump out of the sea. The *AL-2* gave the night recognition signal three times, and followed this by flashing a signal to each of the trawlers. In return two tried to ram, and one of them as she missed opened fire with a three-inch gun. The Yankee submarine was saved only because the last mentioned trawler was so near that she could not depress her gun sufficiently to hit the target and sent the shell screaming over the submarine's bow.

Two months later the *AL-2* was fired on twice by American destroyers, the only damage being the wear and tear on the officers' nerves and the loss of the cook's front teeth. In the first encounter shortly after sunrise, two destroyers began shooting at the submarine at 6000 or 7000 yards range, and kept it up until within 2000 yards, when they noticed the smoke grenades and caught the flashes made by the Aldis lamp, giving the recognition signal of the day. It was in this affair that the cook suffered. He had been standing by the commanding officer, and when all the smoke grenades on the bridge had been used up, he received others as they were hurriedly broken out below. These had a safety device, while stowed away, which was usually twisted off with pincers. But when the destroyers, pumping away with their forecastle guns, dropped a shell within 30 yards of them, the cook did not look for

the pincers, but fastening his jaws on each grenade in turn handed it to the commanding officer with the utmost expedition. When the destroyers, which were the *McCall* and the *Parker,* had satisfied themselves in regard to the submarine's identity and were steaming back to their convoy, the cook showed no interest in them; instead he was gazing ruefully at what he held in his hand—two of his teeth. So far as known, the cook was the only one of the *AL-2* wounded in action.

Ten days later, while proceeding to the billet designated as QF on the confidential charts, the *AL-2* sighted a large steamer escorted by two destroyers headed northeast, and because of other American submarines, which were astern and westward, she thought to hold to her course and speed. Again, in spite of alternate day and night grenades, and the private signal flashed by the Aldis lamp, firing began at 5000 yards and continued at rapidly decreasing range. And when the destroyers had made out the signals and ceased firing, the steamer, like an elderly lady wild with alarm, took it up and positively would not stop until one of the destroyers making a smoke screen steamed across the steamer's bow from starboard to port, and blinding as well as enveloping the frightened dame silenced her.

Still another time, when they were patrolling off the southwest coast of England, it was a friendly airplane that tried to get them.

They were running submerged, with only three feet of periscope exposed. The lookout, stationed at the opposite end of the tube below, suddenly, as if he had made a great discovery, sang out, "Captain, I see some aircraft."

Various gibes followed this observation, most of them to the effect that he was "seeing things," one suggesting that he had been drinking too much coffee, and another that it was strange that he could not yet recognize a sea gull.

The lookout disdained to reply, but a half hour later as again he took his station at the periscope he reported an airship near by.

With this, the *AL-2* came up and the officers opened the hatch, thinking that the airplane might have a message for them. She circled about them flying low, and for about 15 minutes hovered near, making considerable noise. About this time they gave the recognition signal by firing a smoke grenade, and shortly afterwards she flew away.

When they went through a mass of official papers, on their return to Berehaven, they read with unusual interest of the spirited effort made by an airplane to destroy a submarine in the latitude and longitude of their last patrol. The officer of the airplane reported that he had discovered a submarine with only her periscope out; for one-half hour he had tried to drop on her the two 300-pound depth charges which he carried, but had been unable to release them. In his desperation he had attempted to chop them away with an ax, but without success. Then he had tried his machine gun, but just as he was getting the range the blooming piece had jammed. When all his means of attack had proved ineffective, the submarine, which had come to the surface, gave the recognition signal. He did not believe that there was any American patrolling in this vicinity, but as the recognition signal was correct he secured photographs and sketches and flew away to make his report.

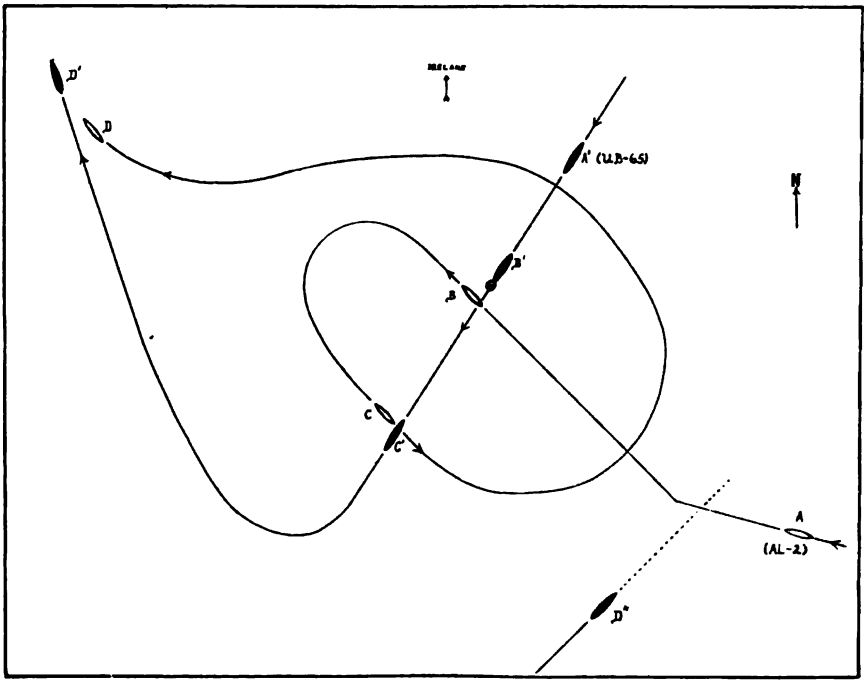
The *AL-2* with the *AL-4* continued to have the lion's share of adventures till the end of the war, but of these only one will be further related, the one great adventure of the *AL-2*.

This occurred on 10 July, 1918, the evening of the day when she had been shot at by the *McCall* and the *Parker* and when the cook was still grieving for his lost teeth. They were returning to Bantry Bay at the close of another patrol, which like all of the previous ones had been full of hard, wearing work, with no visible results. However, their thoughts did not dwell over much on the disappointment, for they would be next morning at Berehaven enjoying a respite.

There was a heavy head sea, and visibility was poor. But these conditions had become such a commonplace that the officer of the deck, Lieutenant Philip Ransom, U. S. N., and the lookout, P. Ryals, radio electrician, 3d class, who were conducting the watch, commented on them merely to congratulate themselves that by zigzagging 30° each 15 minutes they were having spray and not green seas sweeping over the bridge.

At 6.25 p. m., when they were about 15 miles directly south of Fastnet, Ireland, Ryals, who was a Southern lad, with an eye as sharp as his tongue was slow, drawled out, "I see something off the starboard bow. I can't make out whether it's some drift wood or a sail."

The frequent rain squalls from the west made it dark ahead, while there was a bright sky behind them. Ransom could see nothing, and the lookout was not sure of his report. Nevertheless, Ransom changed the course to northwest to investigate the object, which Ryals thought was about three miles distant. When Ransom



PLAN OF ENGAGEMENT BETWEEN THE "AL-2" AND THE "UB-65" AND ACCOMPANYING SUBMARINE

(The *AL-2* is drawn in outline; the German boats are shaded.)

AA', the *AL-2* is sighted by the *UB-65* against a bright horizon; the *AL-2* changes her course on a suspicion.
BB', the *UB-65* is damaged by her own torpedo.
CC', the *AL-2*, having submerged, attempts to ram the *UB-65*.
D, *D'D''*, the *UB-65* becomes suddenly silent; the accompanying enemy submarine runs away.

went off duty, three or four minutes later, he told Lieutenant Scott Umsted, U. S. N., who relieved him, of the lookout's sighting the object, adding, "We ought to be near it now." Further, on going below Ransom reported the suspicion to the commanding officer, Lieutenant Foster, who was working on a navigating chart.

Foster, dropping his chart, started for the conning tower, but before he had reached the control room there was the shock of a heavy explosion. Its violence was so great as to lift the stern quite out of the water, putting out the lights and tripping the circuit breakers. Further, the sharp concussion shifted the engine room plates, and threw the ventilation motors out of alignment—the blades still revolving struck against the casings, making in the darkness a strange and horrible rattle.

"What is it?" asked the commanding officer, as a second later he reached the ladder leading to the bridge, picturing in his mind an airplane hovering over them, dropping depth charges.

"We're torpedoed," replied Umsted, "and the torpedo exploded not 20 yards away. I saw Fritz on the farther edge of the geyser, six feet of periscope, headed this way."

Umsted afterwards related that he had seen a solid mass of green water shoot up on their starboard beam, a little nearer to the periscope that appeared immediately afterwards than to the *AL-2*, and the periscope he estimated to be 50 yards away. After seeing the geyser, he had caught a suffocating whiff of gas.

To avoid a possible second torpedo, Umsted had instantly given the order, "Hard left rudder." Before they had made one-fourth of the turn, Foster took over the command, and estimating the situation in a twinkling, completed the maneuver, supplementing it by sounding the klaxon for a quick dive. His hope was to come about quickly and ram the enemy.

They were taking big risks, for they had made no examination of their hull, and if there was even a slight injury it might be so exaggerated by submerging as to prevent their ever coming up again. The men at first believed that their stern had been blown off, but they showed not the slightest panic. The helmsman, a lad 18 or 19 years old, Omodt by name, rated as seaman, calmly repeated "Hard left rudder," and "Steady," never flinching from his post below. Similarly, A. B. Vogles, chief gunner's mate in charge of the diving rudders, and J. Wade, chief machinist's mate, in charge of the engine room, executed orders with the calmness and precision of a carefully prepared drill.

They did not hit the enemy, but they could not have missed him by more than a few feet, for they passed so close that they could hear distinctly through their own hull his propellers running at high speed. They had gone down to 60 feet to ram him, and were

running at such speed that before they could alter their angle and begin to rise the gauge indicated 100 feet. Happily, it made no difference, for a rapid examination now showed that the hull of the *AL-2* had not suffered the slightest damage.

Listening for a moment on the C-tube and oscillator, they brought the sound dead ahead, and started in pursuit of the enemy with the intention of trailing him until he came to the surface. Within a few minutes, Chief Gunner's Mate Warner reported from the C-tube that there were two submarines in the vicinity, one nearly dead ahead, bearing about 10°, and the other astern, bearing about 180°. For a while the commanding officer thought the C-tube man had made a very common error of reporting a submarine 180° away from its true bearing. So he ordered the course changed 45° and stationed an officer at the C-tube. The bearings, however, were verified and showed that there were actually two submarines. The one to the northward they identified as the boat they had been just operating against; this they knew from the fact that her propellers were still running at high speed; further, she was fairly close. This being determined, Foster again changed his course to northward and continued trailing.

At five minutes of seven, the officer at the C-tube reported that the submarine to northward had stopped, and that her companion, who was going at moderate speed to southward, had begun to call on the oscillator, but was getting no answer. On hearing this Foster stopped and balanced at 75 to 90 feet that they might listen. The foe they had been chasing being absolutely silent, they concluded that she had gone to the bottom—at 50 fathoms depth—either intentionally or because of injuries. Rising to periscope depth, they looked sharply about, but saw only the dark and angry waters.

Then swinging around to the south, they headed for the Hun in that direction, who was still calling on the oscillator. She was heading southeast and quickly drew away from them. As their batteries were not fully charged, on account of one engine being disabled, it was necessary to save their power. Thus Foster gave orders to abandon the pursuit and to return to the position where the northern enemy was last heard. At 7.15 they lost the propeller noise of the southern enemy, and after 7.20 heard no more calling from her oscillator.

For two hours they circled about, stopping frequently at 75 feet to listen in more effectively, and rising at other times to search the horizon with the periscope. Then they imitated the call given by the enemy, at a very high pitch—dash, dash, dash, dot—but their oscillator brought no response. Having come to the surface at quarter of ten and given a final search of the horizon, they dispatched a radio message announcing that they had engaged two enemy submarines and that one was probably damaged. This done, they resumed their course to Bantry Bay.

THE U. S. S. "AL-2" BACK FROM PATROL, BANTRY BAY.

They did not suppose their report would receive much attention, but when Lieutenant Umsted went to London on his next leave he was greeted at the American office in the British Admiralty, with the demand, "Tell us all about it."

The officers of the *AL-2* firmly believed that a German submarine had been destroyed. What happened will never be fully and exactly known. It may be that the torpedo made an erratic run, and returning sank the ship that fired it. Another conjecture is that the German's magnetic pistol for detonating the charge, which according to the British Naval Intelligence Department was constantly troubling the U-boats by not functioning properly, was affected by the *AL-2* passing very near and exploded the torpedo almost in the tube.

Further information relating to the affair, and of such an authoritative character as not to be questioned, was that published three months later in confidential reports by the British Admiralty. They had received intelligence through German sources that the *UB-65*, which was last reported to be operating south of Fastnet, on the date the *AL-2* made her contact, having failed to return had been given up as lost. And with this intelligence, the Admiralty officially credited the *AL-2*, Lieutenant P. F. Foster, U. S. N., commanding, for accomplishing her destruction.

Though the *UB-65* was not destroyed by direct action of the *AL-2*— and the officers of the latter would be the last to claim any such distinction—analysis shows that the conduct of officers and men merits no ordinary praise. The lookout, with the alert eye; the officer of the deck, prompt to change his course to investigate a remote possibility; the second officer of the deck, calm when he thought they had been torpedoed, yet quick to maneuver for a successful defense; the commanding officer, in a flash forming a correct estimate of the situation, and compelling by his daring attack the enemy submarine to dive deep at a time when keeping to the surface might have saved him; the crew, though fully convinced that their plight was desperate, and expecting momentarily the order "Abandon ship," remaining at their stations and instantly obeying the order for "Crash dive"—this is all evidence of a finely organized ship, of officers and men that measure up to our highest naval standards.

PART III. AN ESTIMATE OF THE RESULTS

For four years and a quarter the world had its eyes fixed on the appalling ruin and destruction caused by the German submarines, which not even the all embracing ocean would keep secret. But one of the surprising facts is that the enemy force should not have accomplished more during the summer and fall of 1918. Never did the Allies have more tonnage plying to and from England and France, and at no time did Germany have more undersea boats in commission. The Allies sank some of their boats, yet but a small number compared with the total force engaged. This, though contrary to what was generally believed at that time, is evident by considering data published lately. For although every week the public press published accounts of encounters in which reliable witnesses told of great oil patches that followed

the dropping of depth charges, or described the havoc caused by the mine fields, nevertheless at the end of it all the Germans had available, according to the report of Admiral Sims, 168 submarines, which is 16 more than at the height of their activities in 1917. Why did this great force in the last year of the war accomplish so little?

It was certainly not because the German government had lost faith in their submarines or were abandoning their policy of frightfulness; on the contrary they clung to them with growing desperation, knowing that it was now or never. They were not blind to the host pouring in from America, and they were attempting to nerve the submarine navy to make a supreme effort simultaneously with the stupendous drives made by the army.

One cause for the constant falling off in results was the German Navy's loss of morale. But also we find another explanation. At every turn where there was an important ship, there was not far away a defender. Had the Germans, with reckless courage and a fair degree of skill, persisted in making their attacks, they would have undoubtedly sunk more ships; but also they would have paid the price by their own large losses. This they had not the stamina to face.

There was a prodigious line of defense, constantly being strengthened, which shut in the once powerful German Navy—and this line of defense, if the war had gone on much longer, would have shut in submarines almost as effectively as it did battleships. In this our American submarines had their part.

Of course the quickest and surest defense would have been to destroy the enemy's force. But opportunity to do this, even in part, was granted at only rare intervals during the war, and practically not at all during the period of our participation. Thus it is not a test of the value of our submarines to dwell on the fact that in a year of operations they destroyed only one of the enemy, and that by indirect action, no more than it is of our battleships, cruisers, destroyers, or airplanes. Indeed of the last, though they made 39 attacks on enemy submarines, Admiral Sims reported, "There is no proof that any submarine has been sunk by aircraft." But to correct any wrong impression, he immediately added, "The value of anti-submarine aircraft cannot be judged by successful attacks, as its most valuable work is frequently done in preventing

submarines from attacking shipping." The principle, suggested. applies with equal force to the service of our submarines.

As we turn again to Admiral Sims's report, we read that approximately 200 German submarines were put out of action during the war; and the only measures which he cites as more effective than the Allied submarines in combating them were depth charges and mines.[4] Of the submarines sunk, 90 per cent were credited to Great Britain, 5 per cent to the United States, and 5 per cent to France and Italy. Five per cent is not large, and yet it is not small when one considers how cautious were German tactics in 1918.

We must again emphasize the strategic value of the line of naval defense which America helped to maintain. This was all important about the British Isles, France, and in the Mediterranean. Nor can we say much less of Panama, Chesapeake Bay, Delaware Bay, and the waters about Long Island, Cape Cod, the Azores, and the long ship lanes leading from American ports to Europe—for if there had been any conspicuous gap, the Huns would have been quick to discover it and entering would have inflicted great damage on America when full co-operation was absolutely essential.

It would be worse than foolishness at this time to speculate on the relative honors due to the submarines as compared with other branches of the Navy. Officers engaged in various duty that had intimate knowledge of what our submarines were doing testified as to their value. Admiral Sims in his report said, "The serious hampering of the enemy in his work is the important item in the results by Division Five [American Submarine Force] in its operations." A staff officer whose duty enabled him to observe nearly all naval operations in European waters remarked that our submarines made the enemy "wary," compelling them "to change their cruising areas farther out to sea." It is significant that the *U-117* departed immediately from American waters when she found that the little *E-2* was on her trail; also that Division Five, although making repeated contacts with the enemy during the

[4] Since this article was written there has appeared Admiral Sims's *Victory at Sea,* in which he speaks with still greater emphasis of the work of the submarines: "In the destruction of the German underwater craft, these Allied submarines [in proportion to the numbers employed] proved more successful than any kind of surface ship." *World's Work,* May, 1920, p. 48.

early patrols off England and Ireland, saw them much more rarely during the later patrols.

The War Proved the Making of Our Submarine Service

Both in the Navy and in the country at large there was considerable pessimism previous to the war relative to the submarine force. The boats were regarded as unreliable, and being designed for harbor defense were given their slight practice by themselves without relation to the Fleet. In fact most of their time was spent at the navy yards. Further, whenever there was a disaster it was widely advertised by the public press. Battleships might suffer turret explosions or destroyers might be rammed, with a heavy loss of men and material, but they did not incur public distrust in the same degree as did the submarines. Worse than all else, the officers and men attached to the submarines shared in the pessimism. They knew that in 1916 our force would not bear comparison with that of the great European powers. In justice to America, however, it must be said that we stood where many of the powers had stood two years earlier. Even Germany, who was fired at this time by a consuming passion for under-sea boats, had at the beginning of the war no perception of their great possibilities, as is evidenced by the fact that she had then available only 28 boats; in the years just preceding she had been concentrating all her energies rather on the building of battleships, cruisers, and destroyers. The successes marked by the sinking of the *Cressy*, the *Hogue*, and the *Aboukir* had a decided influence on the building policy of Germany and were a greater disaster to the Allied cause than the loss of several times this number of cruisers. It was only because the United States was not in the war that our country did not share immediately in the enormous stimulus given to the development of submarines.

The war did not continue long enough to change greatly the character of our boats, yet the distrust ended. Whereas previously the chief attention had been given to the improvement of the material, now it was directed to the training of the personnel. In spite of structural defects, our submarines went to sea and kept at sea with great regularity. They responded to the demands made of them. Personnel had triumphed over material.

Advance was made, not only in the cruising efficiency, but also in the science of maneuvering them. Little attention had hereto-

fore been given to the making of submerged attacks. Now they were taught by the British and the enemy. It was the British submarine system which they largely adopted. This had been developed since the war began and it had stood the test of actual fighting. Lieutenant Commander J. C. Van de Carr on taking over the command of the Fourth Division at the Azores, noting the lack of uniformity in the manner of operating ships even in the same division, gave to his officers what he had learned on the *AL-10* in Bantry Bay, under the instruction of Captain Nasmith and others. In the introduction of his monograph on "A Submarine Doctrine of Operations" he remarked, "The British system is unique in its simplicity and the rapidity with which it can be learned. . . . They have kept no secrets from us, and their whole spirit has been one of hearty co-operation." This is not the first time that America has been heavily indebted to England for what she has developed in naval organization. Indeed, is not one of the secrets of the rapid strides we have made in all phases of our national life to be found in the quickness with which we have absorbed a foreign system and made it our own? It is to our credit that this borrowing has commonly been a process of absorption rather than imitation. This has been true in the case of our submarines. The Navy still holds to the idea that the commanding officer must know his boat, every part of it. He must be up in Diesel engines, electricity, torpedoes, and navigation, so as to be able to diagnose any trouble. This is in contrast with the British practice, which commonly leaves the engines to the engineering officer (in most cases a warrant officer), the navigating to the navigating officer, etc. It was a matter of surprise to the British ranking officers that our young skippers should have such a detailed knowledge of their boats.

In this connection, it is interesting to speculate whether our almost entire freedom from casualties in the submarine force was not due in large part to the thorough knowledge of their boats on the part of the American officers and their resourcefulness. During the war the only American submarine lost was the *F-1*, as earlier narrated, rammed by a sister ship on the West coast. To compare with this the large British losses would be unfair and misleading if we failed to note that theirs was for a much longer period, and in performance of duty where the risks were extreme and unavoidable. The duty was not only in the Sea of Marmora and off the enemy's coast in the North Sea, but in the

waters crowded with shipping about the British Isles. The larger number of their casualties came from Allied craft and mines.

If one seeks to make an impartial estimate of the comparative efficiency of the German under-sea force, one must not fail to consider with their widely advertised successes how enormous was the number of their opportunities as they attacked both their enemy's shipping and that of neutrals—at all times of huge proportions. Again and again they failed, either because of lack of skill or because of cowardice. While our largest submarines were of less than 550 tons, scarcely two thirds the size of most of the enemy boats, and they were surpassed in engines and general equipment, it would be hard indeed to persuade an American officer that our force was not unqualifiedly superior ship for ship.

The contempt which American and English officers alike felt for Germans and their methods of submarine warfare is well expressed in the verse of a British officer:

TO FRITZ[5]

I wish that I could be a Hun, to dive about the sea,
I wouldn't go for merchantmen, a man-of-war for me;
There are lots of proper targets for attacking, little Fritz,
But you seem to like the merchantmen, and blowing them to bits.
I suppose it must be easy fruit to get an Iron Cross
By strafing sail and cargo ships, but don't you feel the loss
Of the wonderful excitement when you face a man-of-war
And tearing past you overhead the big propellers roar?
When you know that it's a case of "May the fish run good and true,"
For if they don't, it's ten to one, it's R. I. P. for you?
Although perhaps you can't be blamed—your motives may be pure—
You're rather new to submarines—in fact an amateur;
But we'd like to take your job awhile and show you how it's done,
And leave you on the long patrol to wait your brother Hun.
You wouldn't like the job, my lad—the motors turning slow,
You wouldn't like the winter-time storm and wind and snow,
You'd find it weary waiting, Fritz—unless your faith is strong—
Up and down on the long patrol—How long, O Lord, how long?
We don't patrol for merchant ships, there's none but neutrals there,
Up and down on the old patrol, you can hear the E-boat's prayer:
"Give us a ten-knot breeze, O Lord, with a clear and blazing sky,
And help our eyes at the periscope as the High Sea Fleet goes by."

[5] From *Songs of the Submarine* by Klaxon, London, 1917.

The Future of the American Submarines

At various times during the war the public press proposed that the powers should make impossible a repetition of atrocities on the sea by signing a compact renouncing forever the use of submarines. Reformers were at the same time preaching the doing away with all armies and navies. And yet now, more than a year since peace has nominally come to distressed nations, fighting is still going on through almost the whole stretch of eastern Europe and occasionally on the water. Meanwhile the United States, Great Britain, Japan, and such naval powers as are not too badly crippled in finances as to be unable are going forward with their building programs, including as an important item the construction of larger and more powerful submarines.

In naval circles there seems to be no disposition at the present time to eliminate them. If it be urged that the service on submarines is hazardous, so is that on destroyers and battleships. And in this particular what can be classed with the risks the aero corps are subjected to, both in peace and in war? If it be argued that this weapon was inexpressibly cruel in the war, the answer is the Germans made it so, and they made every weapon cruel, on land as well as sea, and they made cruel their occupation of Belgium, Poland, and Russia. England, though sending her aggressive submarines into the Sea of Marmora and the Baltic, committed no atrocities.

The war demonstrated that the submarine is a hard foe to catch. This the British proved to their enemy's entire satisfaction in the Dardanelles and the Sea of Marmora and in the Baltic. And the Germans persuaded the British and Yanks of the same. Is it not surprising that 33 German submarines (the average number, according to Admiral Sims, that were at sea in the summer of 1918, distributed about the British Isles and France, on the American coast, and in the Mediterranean), this small force with scarcely more men than would be the complement of a single battleship in war, should have kept busy a million British, American, French, and Italian seamen, all on the defensive?

American officers in the Submarine Force, returning from Europe at the end of the war, showed optimism and enthusiasm because they saw the possibilities of the submarine. Whereas it would be childish to belittle Germany's technical achievements, yet an impartial inquiry, we believe, would show that in the

development of the submarine Germany has contributed little. The original idea was English, and American inventive genius made it practical. Even under the great pressure due to war, when the Germans were fully convinced that this craft would bring victory, they developed nothing to compare with the British types. They advertised widely the 2000- and 3000-ton boats they were building, but if there was anything in the type, the war was not long enough to perfect it. They did build submarines of more than ordinary size, with corresponding endurance and cruising radius, but the largest were a disappointment. By their increase in size they had lost in speed and agility. And they were far from being invulnerable.

Much more interesting than the German under-sea dreadnoughts were the British K-boat and the R-boat, both developed during the last of the war. The former is an oil burning ship, with turbine engines, whose propelling force on the surface is steam. She has also a small Diesel engine so as to get quickly under way. She can make 23 knots on the surface, and 8 knots submerged. Just as everything in the K-boat is devoted to speed on the surface, so in the R-boat all is concentrated on speed submerged. This is attained by sacrificing everything to storage batteries. Though compared with her sister ship, she can scarcely more than creep on the surface—7 to 8 knots an hour—when submerged she is capable of 14 knots.

Our submarines demonstrated the progress they themselves had made, when for the first time in the winter following the war certain of their number, the O-boats, joined the Fleet in their practice at Guantanamo. In the Fleet maneuvers they succeeded several times in making successful approaches upon battleships and theoretically torpedoing them.

In any future war with a maritime power, near or far, the officers of the submarine force are fully convinced that their boats will play no insignificant rôle. If the enemy should be remote, the only embarrassment would be the need of a base where fuel, ammunition, and supplies could be renewed and repairs made. Granted this facility, they feel confident of their ability to carry on a protracted war at the enemy's very doors. What greater safeguard could there be for our own coasts?

The future of the American submarine is assured because it is adapted to our national genius. The American youth is full

of resourcefulness, he has the spirit of initiative, and he enjoys responsibility. For the exercise of these qualities only the hydroplane and the destroyer, of our permanent Navy, offer opportunities to be at all compared with those of the submarine. As one young officer who had been at Bantry Bay remarked, "When a submarine is out for an eight-day patrol, receiving during that time not a single order, it is all up to the commanding officer." Highly technical though the submarine is, reserve officers in considerable numbers served on them during the war, and most of them gave an excellent account of themselves. No officers are likely to remain on a submarine for more than a limited period; but the service, however hard and trying at times it may be, that develops resourcefulness, initiative, and responsibility is preparing them for highest usefulness.

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THE POULSEN ARC

By Lieutenant Ellery W. Stone, U. S. N. R. F.

The widespread adoption of the Poulsen arc for all long distance radio transmission and, in particular, its use aboard many ships of the navy and at all high power naval radio stations ashore should make this comparatively recent system of radio transmission of interest to naval officers. It is hoped, therefore, that a paper on its theory and operation may be found of value to those officers assigned to radio duty afloat or ashore and to others interested in the radio art.

The Poulsen arc is unique in that it was probably the first practical system of continuous or undamped wave transmission. While we have witnessed the adoption of the vacuum tube as a generator of undamped oscillations as well as the increasing advent of the radio frequency generator, the Poulsen arc will undoubtedly remain the pioneer in this field.

The Poulsen arc was named after its inventor, Valdemar Poulsen of Copenhagen, a Danish physicist and engineer, and is used abroad and in this country for practically all high power installations. In the United States, credit is due the Federal Telegraph Company of San Francisco for its development.

In the consideration of this system, it may be advisable to review briefly some elementary features of radiotelegraphy.

It will be remembered that J. C. Maxwell, an English physicist, established the electromagnetic identity of light waves. He demonstrated that they were electric waves traveling at the rate of 300,000,000 meters (186,000 miles) per second on or through a medium which, for want of a better name, is termed the luminiferous ether. Considering their similarity to waves on water, we may measure them by determining the distance between two successive crests of a series of waves. This quantity is called the

wave length. The number of waves radiated per second is termed the frequency. Since the greater the frequency of the waves, the more closely will they be separated, it follows that the wave length varies inversely as the frequency.

Hertz discovered that electromagnetic waves, exactly similar to light waves, could be produced from the damped alternating current set up by the oscillatory discharge of a condenser. These waves differed from light waves only in their length—the length of light waves ranging from 750 millionths of a millimeter (0.00075 mm.), the color red, to about 380 millionths of a millimeter (0.00038 mm.), the color violet, while radio waves in practical use range in length from 125 meters to 20,000 meters.

In the various systems of spark or damped wave radio transmission, an initial charge is imparted to a condenser, the capacity of the antenna, and the ensuing, oscillatory, damped discharge gives rise to radio waves. The damping or decreasing values of the alternating current set up by a condenser is due to electrical energy utilized in radiation and wasted in the form of heat set up in the conductors of the antenna circuit and in the imperfect insulators within its static field. This is similar to the decreasing swings of a pendulum which has been drawn to one side and then released, due to the resistance or friction of the supporting bearing and of the air in which it swings. In a clock, however, the swings of the pendulum are undamped—the magnitude of the swings does not decrease—because with each complete swing of the pendulum a new impulse or fresh energy is imparted to it. This is the principle of the Poulsen arc. An initial charge is given to the antenna capacity as in spark transmitters, but instead of allowing the antenna current oscillations to decrease in magnitude, a fresh impulse is given the antenna after each oscillation.

We may inquire as to what advantages obtain as a result of employing undamped waves instead of damped. Briefly, the answer is that it is only with undamped waves that we can take complete advantage of the principle of resonance between the transmitter and the receiver. In addition, absorption of undamped waves in long distance transmission appears to be less. And finally, we are enabled to secure an infinite variety of notes in the telephones at the receiver by means of the modern beat or heterodyne reception.

Fig. 1 represents the fundamental features of the Poulsen arc. It should be understood that this figure is not the exact diagram of connections of the arc as used in service but is to be employed in obtaining an elementary conception of its operation. A source of direct current is shown, usually from 500 to 1000 volts. In series with the arc are the choke coils, L, and the resistance coil, R. The arc is represented by the convention labeled A. Since the arc is connected directly in the antenna circuit, the inductance and capacity of this circuit are here represented by the inductance L_1 and the capacity C_1, respectively.

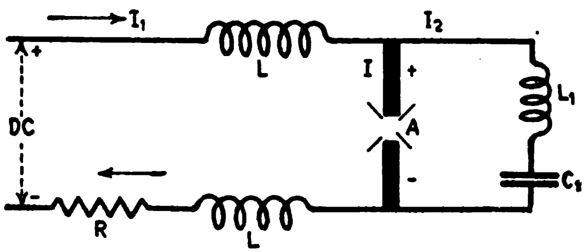

FIG. 1.

The choke coils, L, are used to prevent radio frequency currents of high potential from making their way back from the antenna circuit to the D. C. generator. The principle of their operation is as follows: The reactance of an inductance is given by the formula

$$X_L = 2\pi f L, \tag{1}$$

where X_L is the inductive reactance, π is the numeric 3.1416, f is the frequency in cycles per second, and L is the inductance. Since the frequency of the oscillations in the antenna circuit may be several hundred thousand cycles per second depending on the wave length, f has a very large value giving a correspondingly high value to X_L. The choke coils thus offer a very high reactance to the radio frequency currents from the antenna but do not serve to limit the current from the generator to the arc since the frequency of direct current is zero. (The resistance of the coils is quite low, consequently practically all of their impedance is inductive reactance.)

The resistance, R, in series with the mains serves to limit the direct current to the arc, for if it were not interposed in the circuit, the arc would be practically a short circuit across the line with consequent disastrous results.

The positive electrode or anode is made of copper, the negative or cathode—of carbon. When the two electrodes are touched together and then separated, the great heat caused by the high resistance of their imperfect juncture at the instant just prior to separation volatilizes the carbon and it becomes incandescent—the copper likewise. These vaporized metals now serve as a conducting medium between the two electrodes with the result that current flows across the air gap formed by their separation. This is precisely the same phenomenon that occurs in the operation of the commercial arc light. In the latter, however, electromagnets serve to close and open the electrodes while with the Poulsen arc, the operation is usually performed manually.

Ohm's law states that

$$E=RI, \tag{2}$$

where E is the potential in volts, R is the resistance in ohms, and I is the current in amperes. This relation holds for all metallic conductors but does not obtain with liquids or gases. Instead, with the arc, the potential is given by the equation

$$E=a+\frac{b}{I}, \tag{3}$$

where a and b are constants whose numerical values need not be considered. An examination of this equation will show that since I appears in the denominator of a fraction, increasing values of current across an arc will result in diminishing potentials. Conversely, for very small currents, the potential will rise to a high value.

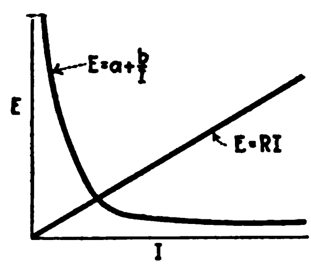

FIG. 2.

Fig. 2 graphically demonstrates the difference between equations (2) and (3). In the former, since the potential varies proportionately as the current, it is plotted as a straight line. Equation (3), however, assumes the shape shown—an equilateral hyperbola.

Returning to Fig. 1, with the arc struck and burning, the current for same is supplied by the generator and is labeled I_1. The direction of its flow is indicated by the arrows. Let us assume that by some means the arc is extinguished. (We shall observe later that this is effected by the blow-out magnets, not shown in Fig. 1.) The extinguishing of the arc with a consequent zero arc current causes the potential across the arc to rise in accordance with equation (3). This potential now serves to charge the antenna capacity C_1. When C_1 has become fully charged, the potential in the antenna circuit is now sufficiently high to break down the resistance of the arc and the condenser or antenna discharge current, I_2, now flows across the arc. (Inasmuch as it was necessary to strike the arc by touching the electrodes together in originally starting it, the inquiry may be made as to how it is possible to reignite the arc in this case without striking the electrodes. This is because the arc is extinguished by the magnets for radio frequency periods only, *i. e.*, a one hundred thousandth part of a second at 3000 meters for example, and remains incandescent and almost conductive when so extinguished.)

Let us represent the total current across the arc by I. With the condenser now discharging, the discharge current, I_2, flows across the arc in the same direction as the generator current so that

$$I=I_1+I_2. \tag{4}$$

We are familiar with the fact that when a condenser discharges, the ensuing current is oscillatory, that is to say, the condenser first becomes charged with one plate positive and the other negative. When charged at a given potential, it discharges—the current flowing around the discharge circuit so that the plates receive charges of opposite sign. The whole operation then repeats itself many times.

Accordingly, when C_1 has become fully charged to the opposite sign, the current I_2 now reverses and flows in the opposite direction across the arc. This current is now flowing counter to the direct current supplying the arc, so that I_2 is now opposing I_1, or

$$I=I_1-I_2. \tag{5}$$

After reversing in direction, I_2 grows gradually larger while opposing I_1 so that it soon becomes comparable in size with the latter. At this juncture, the value of the total current across the arc, I, is so diminished that the magnetic field is enabled to blow

out the arc, whereupon the whole cycle of affairs is repeated as long as current from the generator is supplied to the arc.

Returning to our pendulum analogy, we see how with each complete swing or cycle of the antenna current a fresh charge is given the antenna to keep it always in oscillation just as the pendulum of a clock receives a fresh impetus from the spring mechanism at the end of each complete stroke.

The arc thus serves as a converter of direct current into alternating current of radio frequency, although it should be borne in

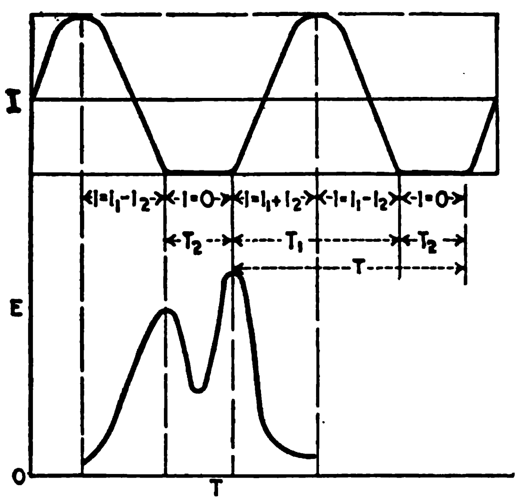

FIG. 3.

mind that its properties as such are based on the fundamental theory that the discharge of a condenser is oscillatory.

Fig. 3 illustrates the potential and current curves across the arc. The abscissæ for both curves is time, the ordinate of the lower curve is potential and that of the upper is current.

One complete cycle of time, T, of the current action across the arc and in the antenna may be divided into parts—the charging period, T_2, and the discharging period, T_1. During T_2, the arc is extinguished, in order to divert the direct current into the antenna circuit for charging purposes, and I equals zero. During the discharging period, T_1, the current across the arc is successively the sum and then the difference of the generator and antenna currents.

It will be observed that in accordance with equation (3), when the current is rising, the potential is falling and vice versa, as shown. In the lower curve, the peak to the left is the potential at the beginning of the charging period or the extinction voltage of the arc. (So called because it is the potential across the arc at the instant the arc is blown out by the magnets.) The potential peak to the right is the ignition voltage as defined in a previous paragraph.

Fig. 4 represents a sine curve, or the current obtained from a theoretically perfect alternator. By comparing the upper or current curve of Fig. 3 with that of Fig. 4, a difference will be seen in that the lower half of the cycle in Fig. 3 differs from the upper half, while in Fig. 4 the two were identical.

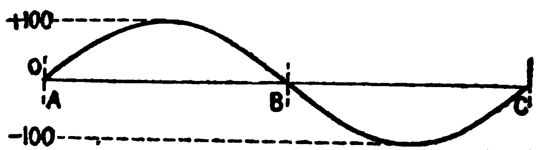

FIG. 4.

From the study of sound in physics, it will be recalled that the fundamental vibration of a string or other sonorous body is often accompanied by overtones or harmonics. In fact, the rich quality of a note sounded on a musical instrument is often due to the pleasing combination of the harmonics with the fundamental. The frequencies of these harmonics are integral multiples of the fundamental frequency. The same phenomenon occurs in electrically vibrating or alternating current circuits. Thus, an alternator delivering current at the frequency of 60 cycles for which it is rated may often show harmonics of 180, 300, 420, 540 cycles and higher frequencies. Ordinarily, these upper harmonics are not noticeable since their high frequency causes the impedance of the average circuit, containing considerably more inductance than capacity, to be so high as to limit their magnitudes and to make them practically non-existent.

When harmonics do exist in an alternating current circuit, however, an oscillograph of the current will show that a sine curve no longer obtains. Instead, the superimposition of the harmonics on the fundamental frequency produces irregularities in the curve. When the same irregularities occur in each lobe or alternation,

it is an indication that odd harmonics only are present. This is typical of the current curve of an alternator whose inherent construction and rotation necessarily insure identical alternations. In circuits possessing distributed capacity and inductance, however, such as telephone and transmission lines, both odd and even harmonics are present. In such cases, the current curve is not symmetrical—the lower alternations being different in shape from the upper. This condition is present in the upper or current curve of Fig. 3 and indicates the presence of both odd and even harmonics in the current across the Poulsen arc.

A radio antenna by virtue of its construction contains distributed inductance and capacity, that is to say, its inductance is not lumped in a coil nor its capacity in a condenser. As a result, its fundamental oscillation is accompanied by harmonics, but—like the alternator—its inherent construction, in this case a grounded lower extremity and an opened upper end, limits its oscillation to odd harmonics only.

It happens, therefore, that when an arc is inserted in an antenna circuit, as is done in the operation of the Poulsen arc, certain of the antenna harmonics, and in most cases all of the lower ones, are reinforced by those harmonics of the arc which nearest approximate them in fiequency. This results in the radiation of several wave lengths from the aerial of a Poulsen arc transmitter—the working wave length to which the antenna circuit is adjusted and which is determined by the fundamental formula

$$\lambda = 2\pi v\sqrt{CL}, \tag{6}$$

where λ represents the wave length, v is the velocity of the radio wave, (see fifth paragraph), C is the capacity and L the inductance, and many odd harmonics whose wave lengths are practically integral subdivisions of the working wave length. (It is only in an unloaded antenna, *i. e.*, one in which no inductance coil or condenser is inserted, that the fundamental wave length is an integral multiple of the wave lengths of the harmonics.)

While the harmonics radiated from an antenna are not comparable in energy magnitude with the working wave length and accordingly produce no effect at a distant station, it happens that they are sufficiently strong to produce considerable interference at nearby receivers, which while not tuned to the working wave length of the transmitter, may happen to be in resonance with one

of its many harmonics. In addition, these short waves may be in resonance with the metallic circuits of the stays and other rigging, thus setting them into oscillation and consequent radiation, with the production of still further local interference.

A complete diagram of the Poulsen arc as actually used in practice is shown in Fig. 5. It will be observed that the shunt circuit L_1, C_1 of Fig. 1 has been replaced by the antenna circuit which includes the antenna, the loading inductance L_1, the arc electrodes *Cu* and *C*, the antenna ammeter and the ground. In addition, the blow-out magnets, *M*, have been inserted in the direct current leads supplying the arc.

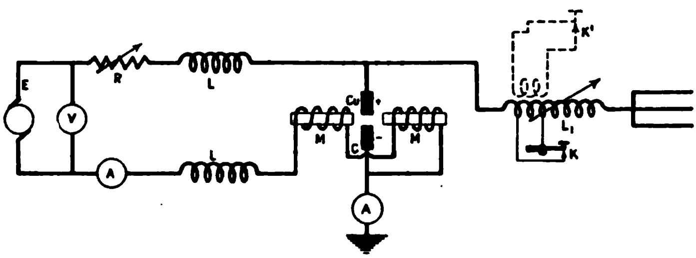

FIG. 5.

The operation of the magnets is as follows: We have seen that for the requisite charging of the antenna capacity, it is necessary that the arc be extinguished in order that the direct current from the generator may be diverted into the antenna. The arc when burning is in an ionized state, that is to say, the incandescent electrodes freely give off ions. These ions serve as the medium of conduction of the electric current across the arc just as they do in the electrolyte of a storage battery. When the ions are removed from a liquid or a gas and electrical conduction cannot take place, we say it is deionized. Accordingly, to extinguish the arc, it is necessary to deionize it or to remove the conducting ions from the air gap between the electrodes.

A current of electricity flowing in a wire sets up a circular magnetic field around the conductor. The direction of the lines of force of this field is determined by the familiar right-hand rule which states that when the thumb of the right hand is pointed in the direction of the current flow, the curved fingers, held at right-angles to the thumb, point in the direction of the lines of force. It has been demonstrated that a stream of ions or isolated

electric charges behaves similar to the electric current in a conductor. (In fact, it is not altogether clear that electrical conduction in a wire does not actually consist of such a stream of electrons.) As a result, a stream of ions sets up about it a circular magnetic field similar to that around a wire.

Let us assume that a stream of ions is flowing away from the reader through the page at right-angles to it. We shall represent the cross section of this stream by a dot. From the right-hand rule, it is evident that there will be set up around this stream a clockwise flux. This is represented in Fig. 6 by the dot and circular arrows.

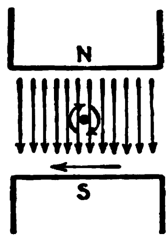

FIG. 6.

Let us now set up a magnetic field at right-angles to this ionic flow. This will require the north and south poles of a magnet and the direction of the lines of force of this additional field will be as indicated by the vertical arrows in the figure. It will be observed that the flux to the right of the dot is added to that set up by the ions, while to the left—the ionic flux opposes that of the magnets. This results in a stronger magnetic field to the right of the dot than to the left with the result that the ionic stream is deflected from the stronger to the weaker field as indicated by the arrow at the bottom of the figure pointing to the left.

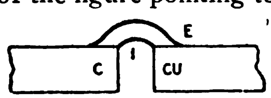

FIG. 7.

In the arc, a transverse field is set up at right-angles to the arc flame and in accordance with the principles set forth in the preceding paragraphs, the flame or ionic stream is blown to one side as shown in Fig. 7. The arc starts at the edges of the electrodes at the ignition point I of the figure, and is blown out to the extinction point, E. In connection with the oscillatory current of the

antenna capacity, the magnetic field thus serves to automatically extinguish the arc at radio frequency intervals.

We have seen that at the longer wave lengths, the frequency is lower, consequently the time period, or the length of time in which it takes one oscillation or cycle to complete itself, is greater. It will be apparent, then, that at the longer wave lengths, the greater time period gives us more time in which to deionize or "scavenge" the arc. Consequently, a weaker field is used with the longer tunes than with the shorter.

Aboard ship, where the arc tunes do not cover a wide range, probably one adjustment of the magnetic field will suffice. Ashore, however, where the arc may be used on widely different wave lengths, it is essential that means be provided for varying the field strength. This is usually effected by employing a switch to cut in or out more or less turns of the magnets. Contacts of the switch are marked for the different tunes to which the transmitter is adjusted.

It will be obvious that the field strength must be properly adjusted for the time period—or wave length—of the antenna since if the field be too strong, the arc will be blown out into a fan so quickly that another arc will be started before the first is extinguished. This will result in two or more arcs burning at the same instant with consequent deleterious irregularities in the oscillations.

On the other hand, should the field strength be too weak, the arc will be extinguished before it reaches the point E of Fig. 7. The next arc will be ignited at the extinction position of the first. This secondary arc may also be extinguished prior to the point E, with—if the field be weak enough—the possible formation of a tertiary arc. This ignition of the secondary and tertiary arcs at points which make the arc lengths longer than normal requires an increase in the supply potential with consequent decrease in the over all efficiency.

In addition to the use of the blow-out magnets, two other agencies are employed to assist in the deionization of the arc. One is effective cooling, and the other the use of hydrogen.

An incandescent metal is a prolific radiator of ions. We see this exemplified in receiving apparatus in the radiation of electrons from the filament of the vacuum tube detector. To assist in deionization, therefore, it becomes necessary to cool the electrodes—

the anode, by the circulation of water through the duct in the copper shown in Fig. 8, and the cathode by the rotation of the carbon, which is geared to a small motor. The arc flame, which, as we have seen in Fig. 7, burns on the edges of the electrodes, is thus enabled to burn on a fresh and relatively cool portion of the cathode at all times. The circulation of water through the anode makes it impractical to revolve it.

Both electrodes are consumed in the burning of the arc and must be frequently renewed, especially in high power installations. The carbon, being the more volatile, obviously must be renewed much more often than the copper. From Fig. 8, it will be observed that it is possible to permit the consumption, through burning, of only a small portion of the anode since a hole will otherwise be burned through to the water supply.

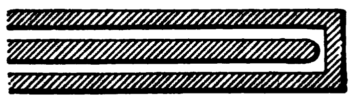

FIG. 8.

To give some idea of the dimensions of the electrodes, it may be stated that while the diameter of the electrodes in the average commercial arc light is about one-half inch, that of the cathode in a 500 kw. radio converter is about one and one-half inches.

Hydrogen gas is admitted to the air-tight arc chamber to assist in deionization since the velocity of the hydrogen ions is higher than that of the gases comprising the atmosphere. This makes it possible to more quickly remove the ions from the space between the electrodes, with consequent increase in the rapidity of extinction of the arc. At radio stations ashore where illuminating gas is available, it is customary to employ same on account of its hydrogen content. Aboard ship, however, it is necessary to use a liquid hydrocarbon such as alcohol which may be volatilized by the heat of the arc chamber. This is supplied to the arc by means of a drip cup automatically controlled.

If hydrogen is not used in the arc, the presence of air will tend to form oxides on both electrodes. These incandescent oxides are very prolific in their ionic radiation—a familiar example to the physicist is the Wehnult cathode ray tube—and deionization by means of the magnets alone is very difficult. The hydrogen on

account of its strong affinity for oxygen serves as a reducing agent and quite effectively eliminates the formation of these troublesome oxides.

Since both methods of obtaining hydrogen described above entail the use of hydrocarbons, it follows that large quantities of carbon or soot are deposited within the arc chamber. This is increased by the natural disintegration of the incandescent carbon cathode. Frequent cleaning of the chamber must be performed, therefore, in order to maintain the insulation of the anode. (The cathode is grounded to the metallic chamber castings.) The carbon collects on the inner walls of the chamber and if present in sufficient quantity will cover the insulated bushing surrounding the anode holder, thus grounding the " hot " side of the generator. In high power sets, the arc chamber is cleaned daily.

In taking down an arc, a word of caution is necessary. Fully five minutes should elapse after the current is turned off—to enable the electrodes to cool—before the chamber door is opened. If the door be opened immediately, the electrodes will still be white hot and will ignite the explosive mixture formed from the hydrogen in the chamber and the inrushing oxygen of the atmosphere. Such explosions have many times resulted disastrously and too great caution in this respect cannot be exercised. In small arcs, an exhaust valve is provided to take care of the initial explosion occurring after each time the arc is disassembled. In large converters, the exhaust-blower system serves the same purpose.

It is interesting to note that with normal operation of the arc, *i. e.*, the production of perfect oscillations in the antenna, the antenna current is always seven-tenths (0.707) of the input direct current. That is to say, the reading of the antenna ammeter should be seven-tenths of that of the direct current ammeter in the generator leads. This relation serves as a check on the calibration of the radio frequency antenna ammeter.

Referring again to Fig. 5, it is noted that the key is inserted in the antenna circuit. This is different from the spark type of transmitter in which the key is inserted in the lead to the alternator as shown in Fig. 9. In the Poulsen arc transmitter, it is not possible to open and close the power supply in the act of signaling since the arc electrodes must be closed to strike the arc each time the circuit is opened. (It is true that the arc flame is extinguished

at each cycle of the antenna current, but these interruptions occur at *radio frequency* intervals and, the electrodes being incandescent, the arc may be reignited by the antenna potential. This is not similar to the relatively slow key interruptions of signaling.) Accordingly, the arc must be left burning continuously and such variation as is made must be effected elsewhere. Usually, this is done in the antenna circuit.

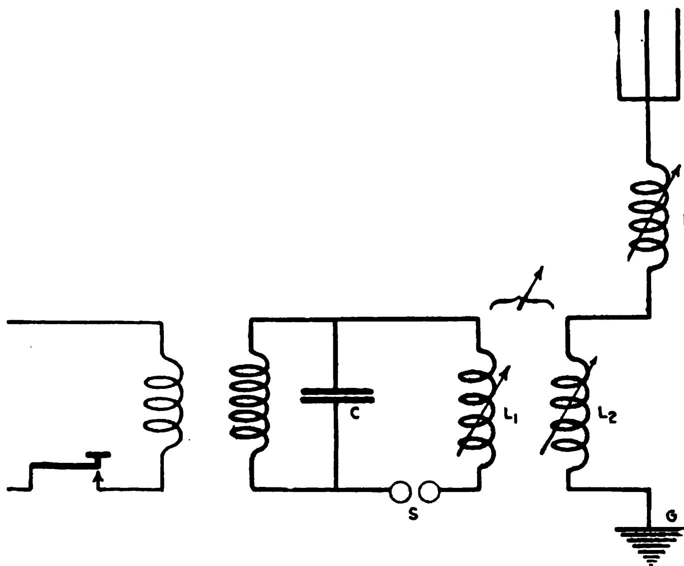

FIG. 9.

The oldest method is to shunt some of the antenna loading inductance with a key. If connected as shown in Fig. 5, see *K*, the radiated wave will be shortened with each depression of the key since the shunted portion of the antenna inductance is in effect removed from the circuit. See equation (6). The signaling or shorter wave is called the *working* wave, the wave length radiated when the key is in the "up" position is termed the *compensation* wave. At the receiver, the operator of course tunes to the working wave and the compensation is ordinarily not heard since the receiver is not tuned to resonance with the longer wave. If the receiving operator should tune to the compensation wave, he would hear unreadable signals corresponding to the spaces between the dots and dashes of the transmitter.

This type of key may be arranged so as to make the compensation wave shorter than the working wave. Instead of placing the key contacts at the front of the key lever or forward of the fulcrum, as shown in Fig. 5, they are mounted at the rear end of the key. With the "back-connected" key, the circuit is closed, and the wave length shortened, when the key is up, and is opened—with increased wave length—when the key is depressed.

It will be observed that with the compensation type of key control two wave lengths are radiated from an arc transmitter—the compensation and the working. This results in just twice the interference from any one arc transmitter, so efforts have been made to design a key system which would radiate waves of but one length as with the modern spark systems. Experimentation led to the

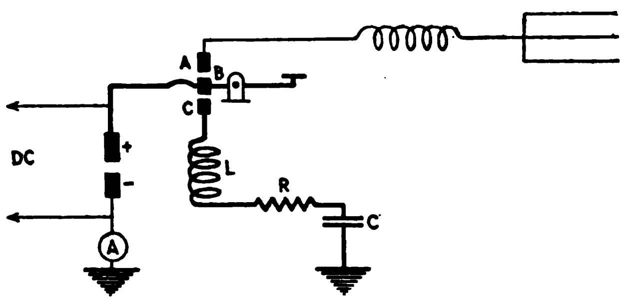

FIG. 10.

"tank" system diagrammed in Fig. 10, the principle of whose operation is as follows: To the rear end of a key lever is fastened a contact, *B*. This engages with the contact *A* when the key is depressed and *C* when it is released. *A* is connected to the antenna while *C* is connected to a dummy antenna or tank circuit, *L*, *R*, and *C* and the earth, the inductance, resistance and capacity of which are adjusted to approximate the respective constants of the antenna circuit. The antenna current ammeter should show no variation in its reading when the arc is switched from the dummy to the real antenna. The tank circuit is necessary in order to keep stable the oscillatory conditions across the arc since perfect signaling cannot be obtained by merely switching the antenna on and off the arc. When not connected to the antenna the arc must be connected to a similar oscillatory circuit.

Such a circuit as described radiates of course but a single wave length since the tank circuit is a closed—and consequently a practically non-radiating—circuit. It happens, however, that in the act of switching from the tank to the antenna there is an instant in which the arc is not connected to either and since it has no oscillatory circuit to keep it functioning smoothly, irregularities in the oscillations develop which spoil signaling. A new system was developed, therefore, which was intended to keep the arc always connected to some form of oscillatory circuit—either the tank or the real antenna.

Fig. 11 shows this new system which embraces the use of two "reactance" keys, one in the antenna and the other in the tank circuit. This type of key is really a transformer, with a primary

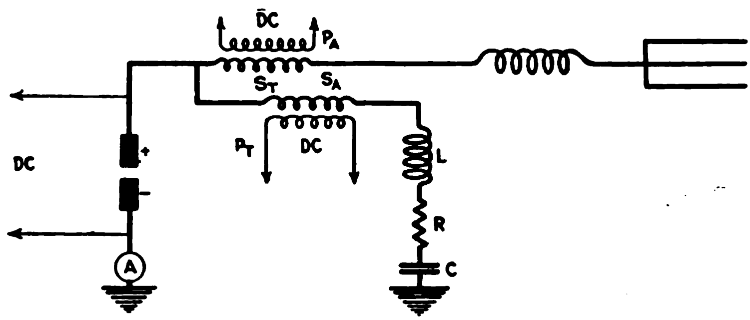

FIG. 11.

through which is sent direct current and a secondary through which the radio frequency current flows. The primary of the antenna key is labeled P_A, the secondary S_A, while the primary and secondary of the tank key are correspondingly lettered P_T and S_T.

If direct current is sent through a coil of wire surrounding an iron core, lines of magnetic force parallel to the axis of the core are set up within it. An increase in the amount of current flowing through the coil will result in an increased magnetic field until finally a point is reached where an increase in current will produce practically no further magnetization. In such a condition, we say the core is saturated, just as a sponge may be so saturated with water that it can absorb no more. If, with the core saturated, we now pass an alternating current through the coil, no reactance will be offered this alternating current since it cannot set up

rising and falling lines of force to generate a counter E. M. F. which will oppose it. If we cut off the direct current, however, the core will be no longer saturated and the alternating current will set up a reactance within the coil which will very effectively limit its value. The same principle is applied to the reactance key.

If sufficient direct current is passed through the primary of the key (transformer), the core becomes saturated and practically no reactance is offered to radio frequency current flowing through the secondary. When the primary is not excited, however, the secondary offers an extremely high reactance to radio currents. A double contact key similar to that shown in Fig. 10 is employed, so connected that when the key is up, contacts similar to B and C close the direct current circuit through the primary of the tank key and, A and B being separated, no current flows through the primary of the antenna key. This gives very low reactance to the tank circuit and very high reactance to the antenna with the result that the tank circuit oscillates and the antenna does not. With the key depressed, the reverse action takes place—the tank has a high reactance and the antenna a low one. Thus the antenna is in effect connected to the arc and the tank removed.

While such a device is theoretically satisfactory, it happens in practice that due to residual magnetism, the transformers soon become sluggish in action and signaling is carried on only with difficulty. In addition, the actual *resistance* of the secondaries of the keys is so high that as great as 25 per cent of the radio current is wasted therein. While this is not harmful in the tank circuit where efficiency is not a desideratum, such a loss in the antenna current is a very serious matter and from the standpoint of efficiency cannot be permitted. The reactance key has had, therefore, a very limited adoption and has been discontinued in all recent installations.

This has necessitated a return to the compensation key but in high power installations, it has not been found practical to use the type previously described on account of the tremendous currents and potential to be broken. The *inductive* compensation key, K, shown in the dotted lines in Fig. 5 is the latest type of arc key to be evolved and has proved very successful. It consists, as shown, of a turn or two of wire inductively connected to the antenna loading inductance, arranged to be short-circuited by a relay key. When the key is depressed, these turns form a closed

circuit and hence exert an inductive influence on the antenna circuit due to the current induced in the former by that in the latter. The flux of this short-circuited secondary is counter to that of the primary or the antenna inductance, and hence reduces the latter's reactance and the radiated wave length. Its effect is thus seen to be similar to that of the *conductive* compensation key.

Since the potential in this closed circuit is too high to be broken at a single key, several keys in series are spaced evenly around the peripheries of the turns. The potential is divided uniformly between all of them and no undue flashing or arcing at the key contacts occurs. Since the impedance of this secondary is practically all inductive reactance—the resistance is made virtually nil by the use of very large, stranded wire—the current broken at the keys is practically wattless. Consequently, no greater sparking occurs at the key contacts of a 500 kw. arc transmitter than does at those of a 5 kw. spark set.

Arc sets have been built by the Federal Telegraph Company for naval installation ashore up to 500 kw. in size while for the radio station built by the navy at Croix d'Hins, France, a 1000 kw. converter was manufactured by the same firm. A photograph of the arc for the latter station is shown in Fig. 12. This type of arc was installed at the naval radio stations at Annapolis, San Diego, Pearl Harbor and Cavite and is the last word in high-power transmitters.

A description follows:

AA—Magnetic core of field.
B—Exhaust pipe, connected to blowers for cleaning chamber.
C—Hose for conducting water supply to and from anode.
D—Anode support.
E—Anode insulating plate.
F—Lead to antenna inductance.
G—Tank containing field coils, insulated and cooled by circulating oil supply.
H—Arc chamber.
I—Door to anode holder.
J—Pipe for hydrogen gas supply.

The cathode, not shown, is on the far side of the chamber.

A photograph of 100 kw. arc converter is shown in Fig. 13 with appended description:

A—Anode.
B—Cathode.
CC—Field magnets.
D—Chamber door.

FIG. 12.

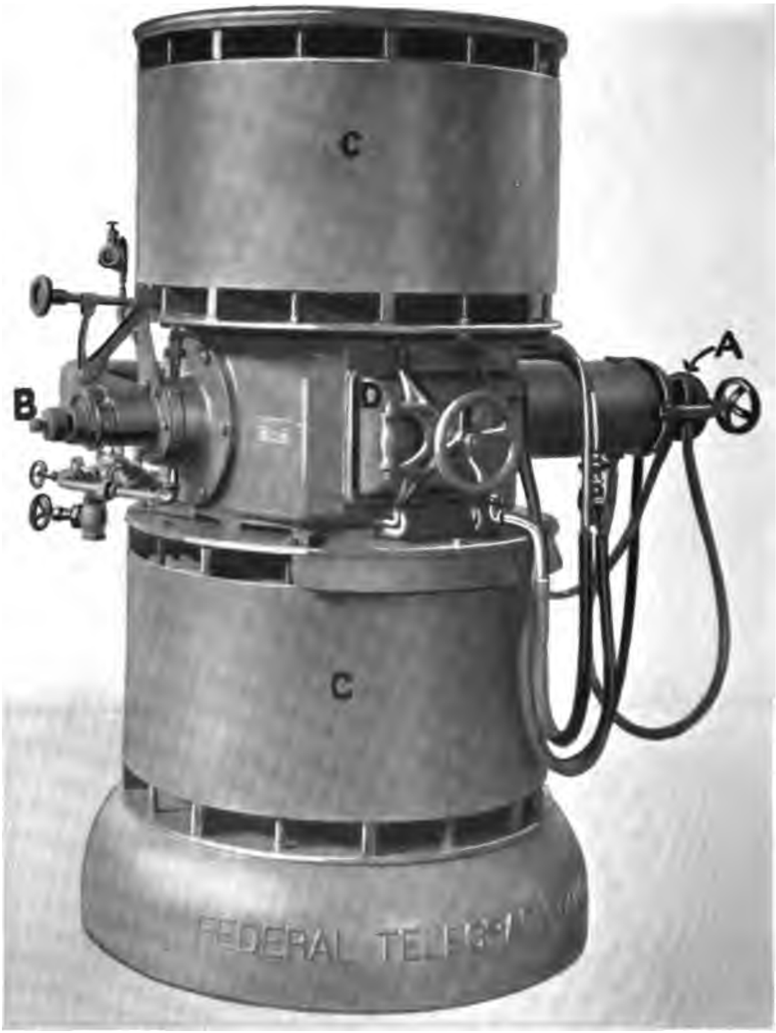

FIG. 13.

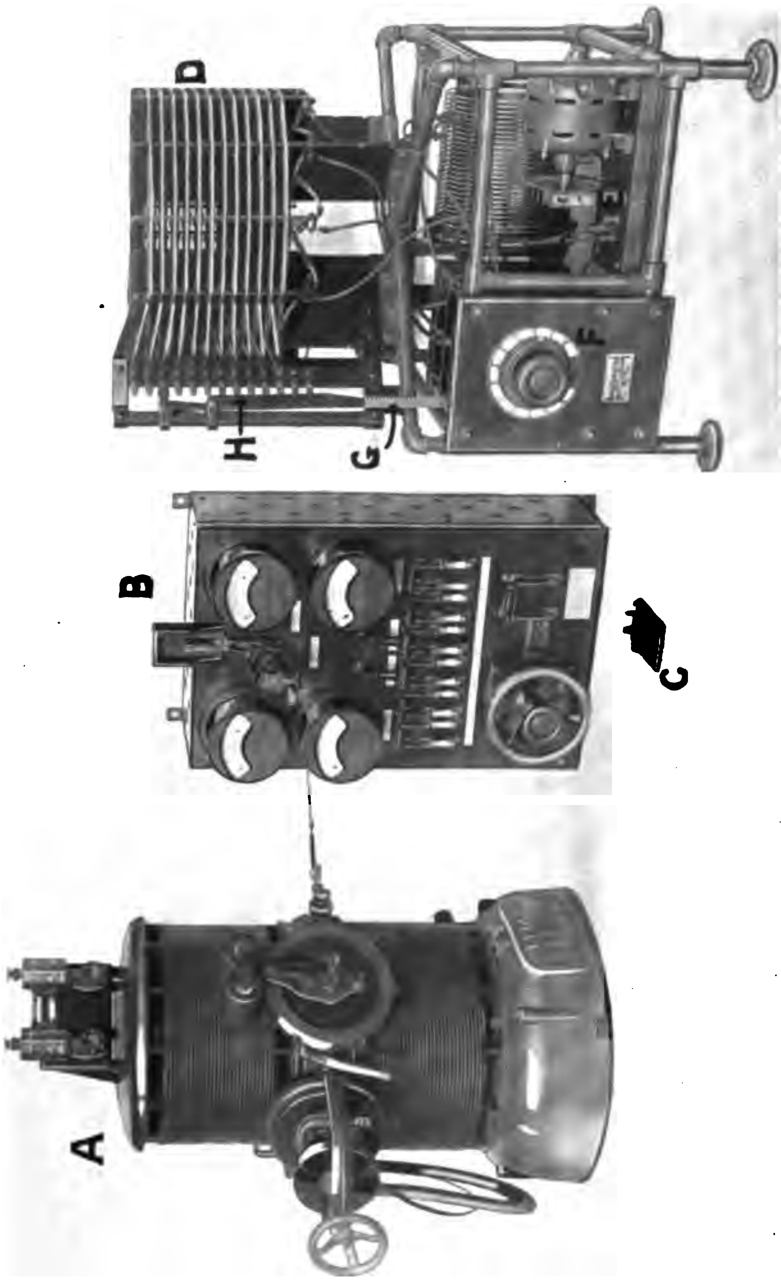

FIG. 14.

With the Poulsen arc, due to the undamped nature of the waves, a single train or series of waves is radiated for each depression of the key. With spark systems, on the other hand, the oscillations die out after each alternation of the transmitter current. Consequently, a separate train of waves is sent out for each alternation

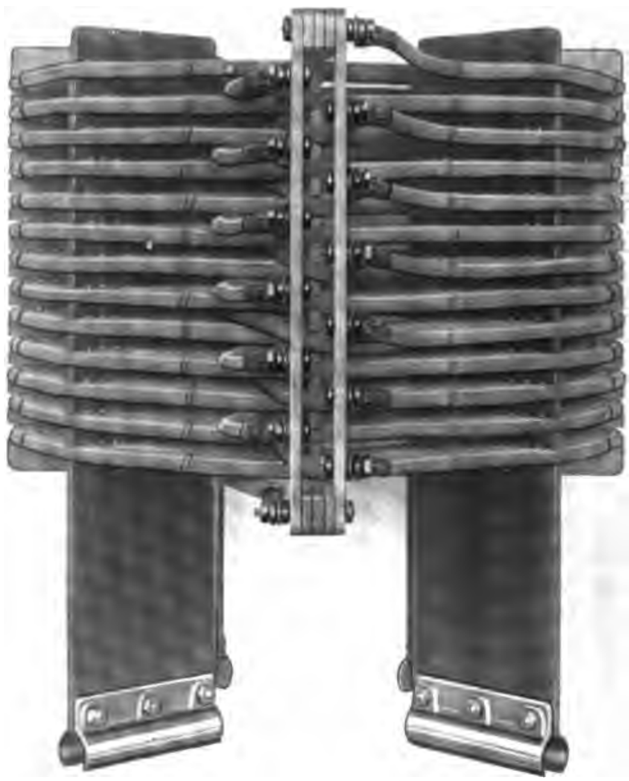

FIG. 15.

of the supply current. Thus with a 500-cycle transmitter, trains of waves are radiated at the rate of 1000 per second. To make signals from a Poulsen arc readable at a receiver designed for spark reception, it is necessary to break up this single train of undamped oscillations into wave trains recurring at about 1000

per second. This is done at the transmitter by means of a motor driven, segmented commutator called a "chopper," inserted in the antenna circuit, which opens and closes the circuit at the frequency mentioned. Such a device obviously may be employed only on low power sets where the antenna current to be broken at the commutator is small.

Fig. 14 shows a complete 5 kw. arc transmitter for ship installation.

A—Arc.
B—Switchboard.
C—Transmitting key.
D—Antenna loading inductance.
E—Chopper—with motor.
F—Wave-changer pinion.
G—Rack engaging wave-changer pinion, connected to wave-changer switch.
H—Wave-changer switch.

Fig. 15 is a photograph of an antenna loading inductance for a 30 kw. transmitter.

Fig. 16 shows a 500 kw. transmitter loading inductance, some idea of the size of which may be gained by comparison with the door in the background. The inductive compensation keys previously mentioned are shown mounted on a cement standard encircling the coil. The electric or static field from a coil carrying a radio frequency antenna current of several hundred amperes is so intense that a network of wire which may be seen strung along the walls and ceiling of the building is required in order to shield the metal work from eddy currents induced therein.

Fig. 17 shows a wave changer switch for a high-power installation operated by a 5 h. p. motor controlled by contactors which, in turn, are operated from a small remote control switch at the arc engineer's desk. The necessity for excellent insulation on account of the high potentials involved is demonstrated by the size of the porcelain insulators supporting the contacts and by the rounded metallic caps for the reduction of the brush or corona discharge.

In closing, I desire to acknowledge my indebtedness to my publishers, the D. Van Nostrand Company of New York, for their courtesy in permitting the reproduction of the accompanying diagrams and photographs from my book, "Elements of Radiotelegraphy."

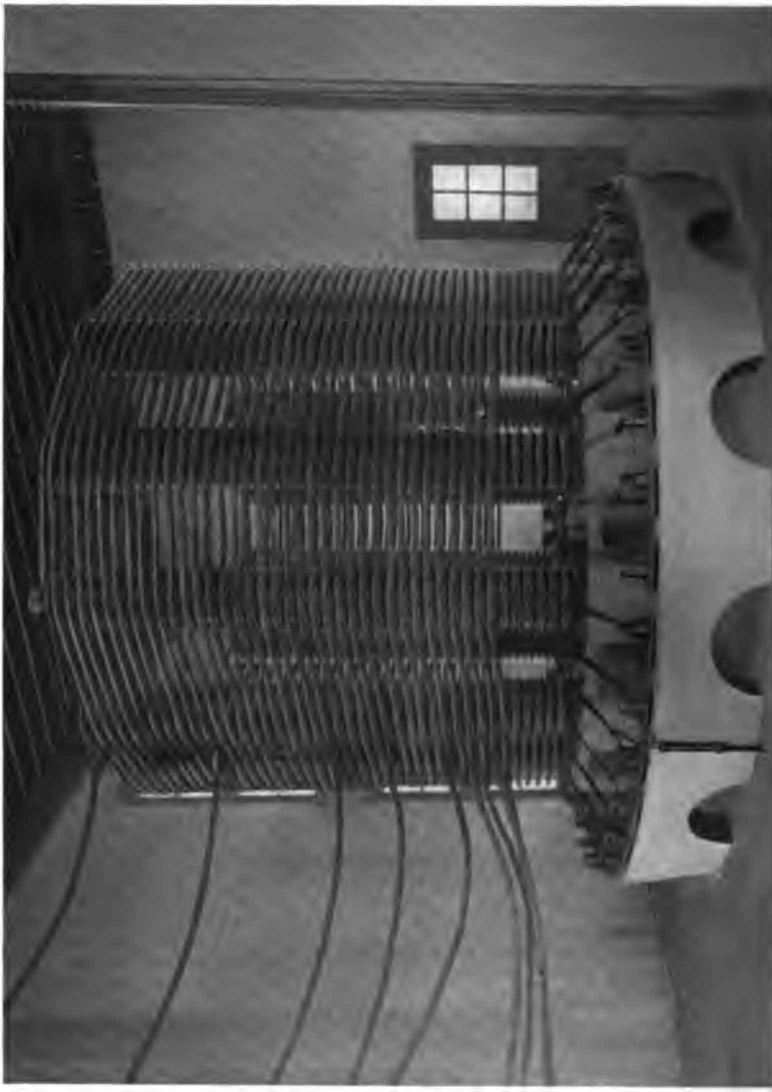

FIG. 16.

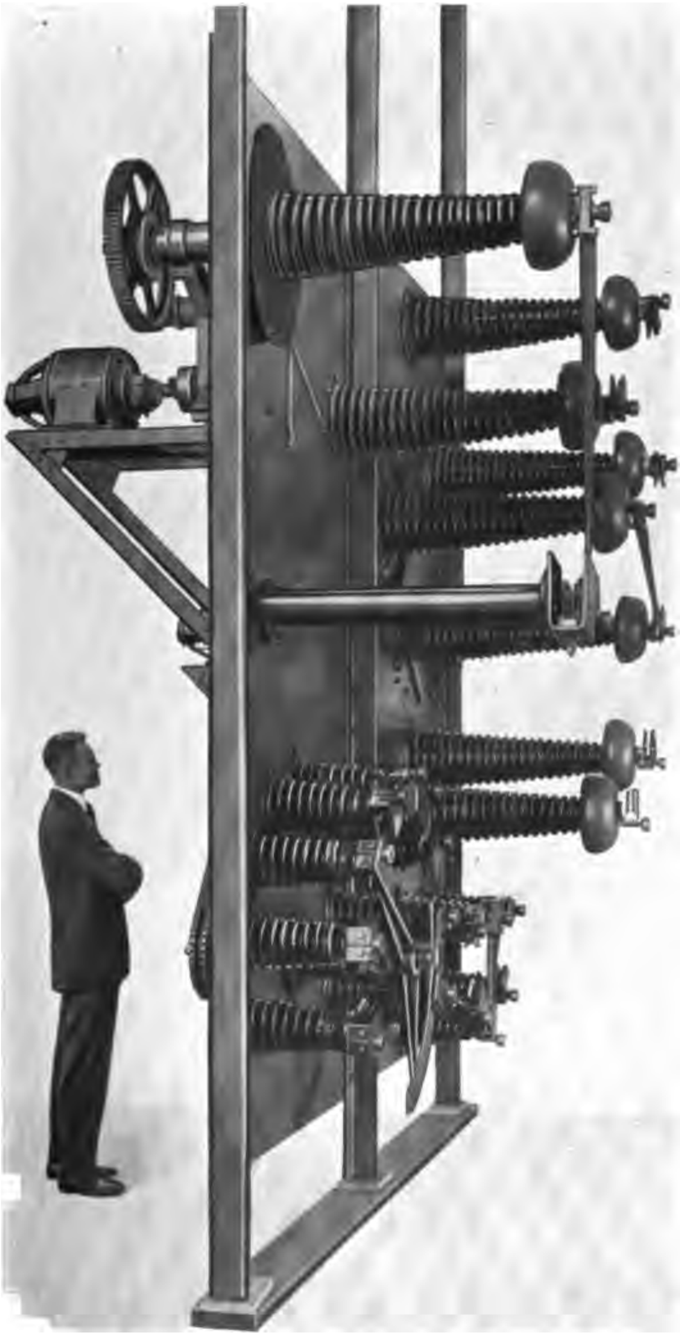

FIG. 17.

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ANOTHER "WRINKLE" IN NAVIGATION

By Commander H. K. Hewitt, U. S. Navy

There are many conditions under which it is desirable to have as much work as possible completed before the sight is actually taken. Most navigators are entirely familiar with this situation and it is unnecessary to go into the many advantages often derived therefrom.

Under the conditions upon which one can decide beforehand what stars he will use, with a little experience, he can also predict, within a few minutes, the time of his observation. Having selected a watch time, and a position point, he can, using Marcq Saint-Hilaire or Aquino, work out the whole sight beforehand and have his azimuth and computed *h* ready.

Going further, the altitude correction can be picked out and applied to this computed *h* with sign reversed, giving a computed sextant *h*. Setting the latter on the sextant, the star is readily picked up, and the necessity of setting on zero and then "bringing down" the star or "bringing up the horizon" is eliminated. This means much, especially to a destroyer navigator in a seaway.

The above work being completed, nothing remains but to observe the star at the selected time, apply the altitude obtained to the computed sextant altitude for the altitude difference, and plot. One can even go so far as to have the position point and azimuth line ready plotted.

The foregoing can, of course, be used for a sight of the sun as well as of any other heavenly body. Moreover, should one, for some reason such as clouding over, be unable to make the observation exactly at the selected time, his work is not lost, provided he can get his altitude within a few minutes of this time.

Should the watch time be different from that selected, it is simply necessary to shift the longitude of the position point by a like amount in order that the *t* used in the computation will remain unchanged. Following this through, it will be seen that this is simply a matter of converting the time difference into arc, and applying it to the assumed longitude, west if the sight was taken late, and east if taken ahead of time.

The limit of time difference that can be safely used without introducing an appreciable error depends principally upon the rate of change of azimuth. If the hour angle is large and the azimuth changing slowly a difference of two or three minutes is not too much. However, should the hour angle be small, and azimuth be changing rapidly, the time difference should be kept as small as possible.

If the navigator is one who prefers the average of a series of observations, instead of one observation, he can take his observation so that the average watch time will be near the selected time, and apply his time difference as before.

There is nothing new or original about the above, as I believe it to be used by a number of navigators. It is not as flexible in the matter of time as the method proposed by Commander Pryor, but where it can be used, has many advantages.

An example is given: Suppose that it is decided to observe star Sirius at $7^h\ 00^m\ 00^s$ p. m., watch time, March 1, 1919. Position point: Lat. 18° 56′ N., Long. 74° 50′ W.

	h m s		
W. T.	7 00 00		
C—W	4 53 27		
C. T.	11 53 27		
C. C.	+ 6 05		
G. M. T.	11 59 32	Mch. 1.	
R. A. M. ⊙	22 32 57.9		
Corr. (Table III)	1 57.1		
G. S. T.	10 34 27		
λ W.	4 59 20		
L. S. T.	5 35 07		
∗ R. A.	6 41 37		
t	1 06 30	log hav	8.32017
L.	18°56′ N.	log cos	9.97584
d	16 36.6 S.	log cos	9.98149
		log hav	8.27750
		nat hav	.01894
L~d	35°32′.6	nat hav	.09316
Z	39 07.4	nat hav	.11210
h (comp.)	50 52.6		
—corr.	+ 6.1	*Az* 155°	
sext. *h* (comp.)	50°58′.7		
sext. *h* (obs.)			
a			

All the above work is completed before taking the sight. Now suppose, for some reason, that watch time of observation is $7^h\ 00^m\ 35^s$ instead of $7^h\ 00^m\ 00^s$.

Diff. = 35^s later = 8′.8 W.
Long. assumed 74°50′ W.
λ′ 74°58′.8 W.

λ′ is then used in plotting the line.

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HAULING 'EM OFF BEFORE DINNER

By Captain R. Drace White, U. S. Navy

The skies are blue in the island of Jamaica. Blue with a blue that comes only from chalk soil underfoot and a cloudless dome overhead. The air is balmy, the flowers are bright, and a comfortable laziness envelops you from the time you finish your bath before breakfast till you take your swim before dinner. Not an overpowering laziness, however. The well-kept tennis courts and the genuine enthusiasm that pervades the atmosphere at the Tennis Club sound a call that is irresistible to the fan. The golf is fair. The roads are a motorist's delight. And last, but not least, the so-called invasion of personal liberty exemplified in the latest nervous stride of a more powerful and prosperous community on this side of the Atlantic in its forced march toward higher civilization has left Jamaica untouched—and exchange is only $3.26 to the pound.

It was in the midst of this setting that the *Prometheus* found herself on February 7, 1920, in the harbor of Kingston. Her mission (to quote *verbatim* from her orders) was, among other things, "to promote contentment." Practical interpretation meant principally to give liberty to the crew. It was a fulfillment of the "enlist and see the world" promise so prominently featured in recruiting propaganda. It was also probably intimately related to the "improve the morale" campaign now prominently vogue, which more frequently, however, finds expression in intensely moral motion pictures produced by the greatest motion picture producers in captivity. Be that as it may, Kingston on that particular day bade fair to prove herself an ideal spot for the promotion of contentment. A motor ride and picnic had been arranged for the men. There was a tea and a dance for the officers. And for me there was to be a dinner. Not an ordinary

dinner. A special one. Some old friends I had run across at the Myrtle Bank; some new ones made at the same place; some relatives of old friends; and—contentment.

Figure to yourself, then, my peevishness when, on that very morning, a gentleman whose visiting card declared him to be "Harry Hitt, representing the United States Shipping Board" came on board and requested me to go down the bay and undertake the salvage of the Shipping Board Steamer *Bartholomew* which had gone aground there two days previously and defied all attempts of the local salvage facilities to refloat her. It meant calling off the men's picnic, it meant breaking up several discreetly progressive flirtations on the part of the officers, *and* it looked as if I should surely miss that dinner.

Mr. Hitt was very anxious for my assistance. As I have said, the preliminary attempt of the local salvage company had failed completely; and although they still thought that for $25,000 they could muster assistance from elsewhere and eventually float the ship, there would be considerable delay, the cargo would have to be lightered out of her, and the loss altogether would be enormous.

I had no doubt of our ability to pull the ship off if we undertook it. *Prometheus* is fitted with a superb towing machine, a 7¼-inch steel hawser, a good capstan aft for handling smaller lines, and engines that never seem to tire of pushing her along. The *Bartholomew* might come off in pieces. She might bring the whole island of Jamaica with her; but come she would once we got hold of her. It was only when I thought of my "mission" that I wavered. It was already nearly 10 o'clock, there was steam on only one boiler, it was a long way down the bay, she was in no danger and might just as well wait till Monday. . . . .

Still it had to be done, and had therefore best be done at once. I ordered steam to be got as quickly as possible and had preparations made to get underway. I sent a messenger to stop several dignitaries from coming on board to repay my calls of the previous day. I went myself and excused myself from a luncheon at the Myrtle Bank, came back on board and got underway as soon as steam was ready, viz., in about one hour. It will be observed that I kept my dinner engagement under my lee. I *hoped* to get back in time.

Mr. Hitt had described the *Bartholomew* as of 2598 gross tons, 1615 net, registered at Cleveland, and chartered from the Ship-

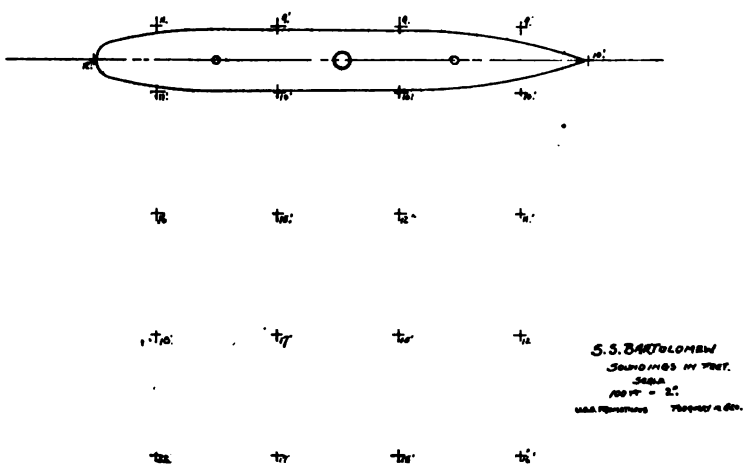
ping Board by the Tropical Steamship Company of 32 Broadway, New York. She was commanded by D. W. Holmes, master, had sailed from Kingston for St. Ann's Bay, Jamaica, two days previously—incidentally sailing without a pilot, although pilotage is compulsory for merchant craft in Kingston. The reasons for this particular eccentricity on the part of the master, I refrained from discussing, although I had my suspicions. For reasons, undoubtedly similar but which I similarly refrained from discussing, the master had attempted to take an overland route to sea. This, as we all know, is seldom done with success and he only got half way across. According to Mr. Hitt, his ship, which normally drew 17 feet, had, at the time of our conversation, only 12 feet under her stern. She had less under her bow.

Things looked worse from down by *Bartholomew* than they had from the anchorage up town. She surely was fast aground. To make matters worse I found when I got down by her, that the topography on the chart was all out. It was impossible to get a fix that was entirely above suspicion. Using one set of marks, we plotted in one spot; using another, we went somewhere else; and so on, depending on the number of combinations we employed. There was no particular disadvantage in this except that it forbade my being too free and easy working up close; for of all rules to be observed in work of this character, the cardinal one is to keep clear of the ground yourself.

However, I let go fairly close and went aboard with the navigator (who is also the executive) to see where she really was. We cut her in using two light-houses and a clock tower as the most dependable of the apparently shifting landscape—and immediately decided she couldn't possibly be there. However, that was of little moment. The matter was easily solved by making an improvised chart of our own for that particular locality. We got from the master his soundings round the ship. We ran lines parallel to her keel line approximately 15, 30 and 45 yards away. In order to properly line up the soundings they were only taken when certain objects on the ship appeared in line to the observers in the boat which was doing the sounding. These were the break of the forecastle, the forward edge of the bridge, the after edge of the deck house, and the break of the poop.

These soundings developed well enough the bottom between *Bartholomew* and deep water. They showed that she had gone up

at an angle of about 45° with the edge of the shoal. They also showed that although there was considerably less water at her bow than at her stern, her bow was free of the bottom by about a foot, this because she drew normally considerably less water at the bow. It was therefore apparent that the only thing to do was to pull her bow out at right-angles to her keel line. This would result in more of her becoming water borne as she moved, and once she was headed for deep water I had no fears but that she would come off. (It is of interest to note that the local company had tried to haul her off by the stern.)



One result of my visit to *Bartholomew* was the decision to send my own men with an officer to her to "assist" in the work there. Lieutenant Stevens was sent, and did signal service. I could frequently hear him clear aboard here. But that was only when the master tried to get "the boys" up from below at an unusual hour to pass a line, or something similar—an effort which usually was abortive. Another reason I had for sending my men was I was fearful of my fine towing line being damaged by being made fast to something that would chafe it. That *would* have spoiled my day. His whole ship wasn't worth damaging that line; for that would have meant reams of future typewritten correspondence, full of servile explanation and acid recrimination. No, his whole ship wasn't worth it.

Having arranged these matters I went back on board *Prometheus*. In the meantime, a 5-inch messenger had been placed in a sailing launch and got ready for running and I lost no time in taking up a position with *Prometheus* abreast of *Bartholomew's* bow as close as was safe. This had to be pretty close if time was to be saved. At best it would be a long job, for the wind was blowing directly from *Bartholomew's* bow toward the position I must take, and it was therefore inevitable that *Prometheus* would swing with her business end away from the work in hand, thus increasing considerably the distance the lines had to be run.

HAULING STERN UP TOWARD "BARTHOLOMEW."

Still, there are tricks in all trades. Instead of trying to drag the wire line along the bottom the whole distance, I ran first (after the messenger) an 8-inch Manila, which of course floated and ran easily; with this I wound ship with stern to and hauled up close before running the wire.

There was another trick, too. It would have been very slow and difficult to haul the stern around broadside to and up against the wind, so as soon as the 8-inch was fast, I hove up my anchor and let the wind swing the ship as the line was hove in. She swung very lively and with no particular strain. This moreover allowed me to place my anchor exactly where I wanted it and left

me free to see that the stern was hauled in as close as was safe. I had the chain left free to pay out, and took a leadsman to the stern where the heaving round had been going on merrily all the time. When we had got in as far as the depth would allow, I had the forecastle haul to the compresser and the after capstan tautened up on the 8-inch. Our stern was then only about 150 yards from *Bartholomew's* bow.

Even then, however, it was a question whether the 5-inch messenger (which, while the winding process had been going on, had been run back to us) would be strong enough to drag the wire hawser across the now relatively small intervening space. However, I made a try, but instead of letting the wire drag on the

BRINGING THE MESSENGER BACK TO GET THE WIRE HAWSER.

bottom, I had a sailing launch come alongside it and support it with a sling about 15 fathoms from its end. The winch on *Bartholomew* then hauled the launch along with the wire, the launch supporting the wire and keeping it off the ground as it went. The operation was done very quickly and successfully.

I had been fearful, however, that the 5-inch messenger would not do the trick and in the meantime had got an 8-inch messenger in the other sailer ready to run it in case the 5-inch carried away. But it was not needed. After a few anxious moments while the end of the wire was going up *Bartholomew's* side the danger was passed and the extra 8-inch was passed back aboard *Prometheus*.

Now came the question of making the end fast. When I went aboard *Bartholomew*, I told the master to shackle my wire into

his bower chain. He had complained that he could not unshackle the chain from his anchor, but I showed him how to do it and he agreed. I suspected, however, he would not do it, and sure enough when all was ready I saw that although he had lowered his anchor away in the hawse-pipe, the anchor was still shackled up. He had passed instead several turns of wire through the hawse-pipe and over the side and had rigged a shackle over all the parts. I was a bit skeptical of that arrangement's holding, but it was too late to change. If it held, it would be all right, if it carried away it would be a lesson to him. Running the line again would not be so difficult, particularly as I had him leave the messenger bent on to the end of the wire and coiled down free to run so that in case his sling carried away, he would still have the messenger fast to the wire and could easily haul the end back on board. By the same process of reasoning I still kept my 8-inch Manila fast to him, but had the end on board *Prometheus* faked down and an easy turn taken on a bitts, so I could make fast and keep our stern from swinging away in case anything carried away. (The wind, be it remembered, was blowing from right aft when we were hauled up for towing, and would tend to swing us away.)

However nothing carried away. We hove down on all the frictions on the towing engine and turned steam on the cylinders to the limit, and got every one clear of the hawser. I got a range on shore at right-angles to our pull, and went ahead, gingerly at first, then to the limit. It was soon evident that we were moving, but I knew it was too good to be true, for I had heard the safeties on the towing machine blow off one at a time and knew that the machine was not holding. I therefore stopped, made sure that the chain, which had been hove in as we forged ahead, would pay out, went aft and reeled in on the hawser till our stern was close up again. By the way, this towing machine is a great institution. All you have to do when you want to haul in on the line is to open the valve. All when you want to make fast is close the valve and set up the brakes. No shifting from bitts to capstan with stoppering and forehanding—no nothing.

Having got where we wanted to be, the brakes were set up for a full due, and the other precautions taken, and all was ready again.

Once more slow and then a full due. Never once did the line surge. It came taut and stayed taut. The range soon told me that *Bartholomew* was moving. All of a sudden, she spun round on her heel and swung into line with the tow. The master went ahead with his engines and in a moment she was off.

In the master's enthusiasm, he nearly ran us down before he would stop his engines. The ground on the opposite side of the channel was bad to work in and I couldn't use my engines much to maneuver. By recourse to the megaphone, however, I got him to stop in time. He begged me to tow him further

"BARTHOLOMEW" COMING OFF.

away from the scene of his disaster, but nothing doing! I saw he would ride clear where he was, so I made him anchor and let go my lines.

The Manila was got free in a jiffy, but of course it took some time to free the wire. In the meantime, instead of anchoring, I let *Prometheus* ride by the stern to the wire hawser and the wind, which now had shifted and was blowing up stream, had me pointed fair for Kingston by the time the wire was cast off. I was thus saved the time of turning round.

Full speed ahead on both engines, reeving in on the line as we went, and a short time afterward we were anchored in our old berth off Kingston, in time to wash up, doll a bit, and keep the

dinner engagement on shore. Believe me, I needed the wash. Also the dinner. It had been a great day. It continued to be.

The next day was also great. *Bartholomew* steamed saucily up the harbor, came to, and sent the following message which we intercepted:

SHIPBOARD
Washington, D. C.

Prometheus hauled *Bartholomew* off mud bank no damage no salvage stop will proceed.

SUPERCARGO.

The supercargo also wrote a very nice letter to the ship, thanking us for our services and assuring us that he was sending "commendable letters to the Secretary of the Navy and the United States Shipping Board, respectively, in reference to your excellent seamanship and hearty cooperation." It made me feel that after all there is such a thing as "Freemasonry of the Sea." There was also real enthusiasm in his wave to me from the lower bridge of *Bartholomew* as that ship steamed out to sea somewhat later passing us close aboard.

I held my breath as she was going through the part of the channel that had been her undoing some days previously, but nothing happened. The ship was at last outside and headed fair for the open sea—the only safe place for a sailor. And I—I returned to my mission.

The only unusual thing about the operation I have described above lies in the fact that the job was done quickly and without any untoward incident. We didn't get aground ourselves, didn't get any lines foul of our propellers, didn't carry away any lines, didn't use any profanity beyond the absolute needs of the occasion. I leave it to you whether the story is worth the telling.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

DIRECTOR FIRE A CENTURY AGO

By Lieut. Commander W. H. P. Blandy, U. S. Navy

Director fire a century ago? "Nothing of the kind," you answer; "they loaded the old smooth-bores with black powder and round shot, sighted down the line o' metal, and let her go." And yet a system of fire-control bearing all the ear-marks of present-day director firing was proposed in those same days of smooth-bores and round-shot.

In director fire the guns are laid to a common angle of elevation, trained to converge upon a point of known range and bearing, and fired simultaneously from a single station more or less removed from the immediate vicinity of the guns. Such a system is what William Kennish, Carpenter, R. N., tried to achieve in 1829. At that time the British Admiralty was asking the service periodically the following questions:

1. "Is there any device to preserve a general level in a ship when heeling or otherwise? If so, describe it."

2. "Is there any method for concentrating the fire of a ship's broadside?"

These questions were undoubtedly born of the many actions in the late eighteenth and early nineteenth centuries, in which tons of shot were expended with extremely meager results, due both to inaccuracy of the fire and insufficient striking energy of the shot. As an instance of poor shooting, the action between the *United States* and the *Macedonian* resulted in only 100 hits in the two hulls, out of about 2500 rounds fired. And a good example of insufficient penetrating power is the *Chesapeake-Shannon* action, after which, although it was fought throughout "within hail," shot were found sticking in the sides of both ships. Again,

in the battle of Navarino, the *Albion,* "74," fired nearly 7000 rounds without sinking a ship. The *Genoa,* "74," in that action lay for 3½ hours so close to her antagonist that the whites of the Turks' eyes were visible, and fired away 7000 pounds of powder with shot in proportion, but failed to sink or destroy her opponent. Small wonder then, that the Admiralty sought improved means of fire direction and control, and "a method of concentrating the fire of a ship's broadside"!

In attempting to solve the problem of concentration Kennish decided upon five different "fires" on either side as being sufficient to cover all conditions of range and relative bearing likely to arise in an ordinary action. No. 1 fire converged the guns upon a point only 90 yards from the ship, and abeam of the midship section. No. 2 fire and No. 3 fire were also abeam, at ranges of 500 yards and 800 yards, respectively, the latter being considered the "maximum effective range"! Nos. 4 and 5 each gave a range of 500 yards, and were directed two points forward and abaft the beam, respectively. (See Fig. 1.)

The means of training the guns upon these five points consisted of wooden "breast-pieces" pivoted at the gun ports. These were capable of being set in azimuth to any of the five positions necessary to align each gun according to the fire desired. (See Fig. 2.) The breast-piece having been set to the "fire" ordered, the gun carriage was run squarely against it, upon being returned to battery, and the gun was thereby properly trained.

The "elevation indicator" was somewhat similar to that for train, being simply the usual wedge-shaped "quoin" which was moved forward or backward along the "bed" under the gun, thus raising or lowering the breech. Kennish graduated his quoins in degrees, and also marked numbers upon them to indicate the elevation necessary for each "fire." Fig. 3 shows the arrangement of the gun, bed, and quoin, and also a form of "gunner's quadrant" in the muzzle of the gun, used in graduating the quoin. In addition to this means of showing the elevation, each gun was fitted with a simple open sight, graduated for the different "fires," to be used when heavy rolling required each gun captain to choose his own instant for firing.

By far the most interesting part of the system, in its relation to modern gunnery, is the instrument which Kennish invented for

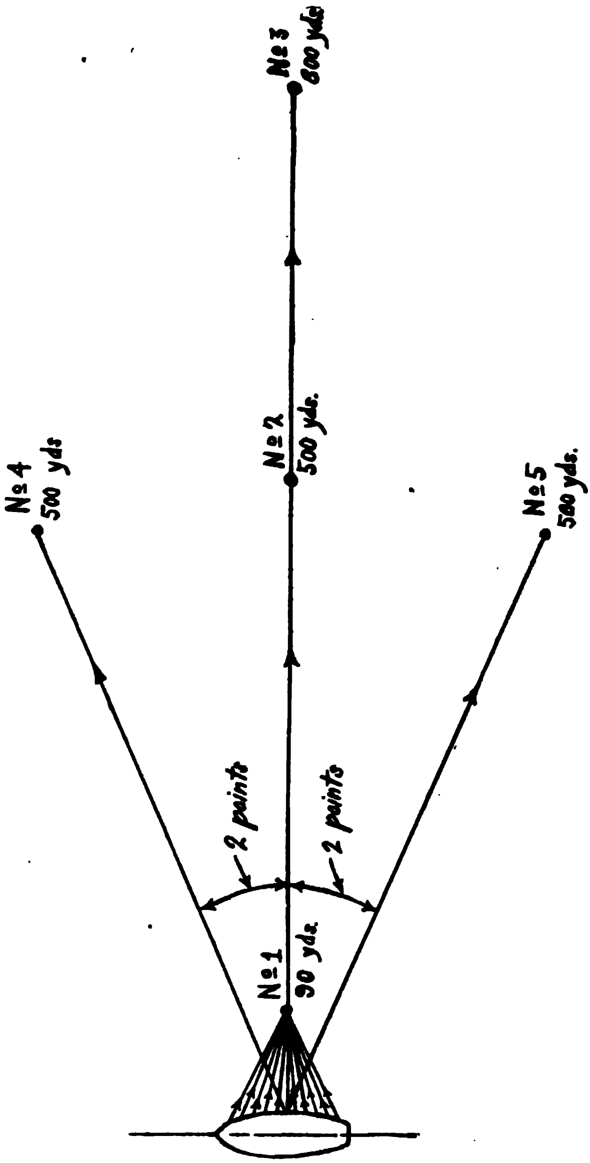


FIG. 1.—The Five "Fires," or Points of Concentration.

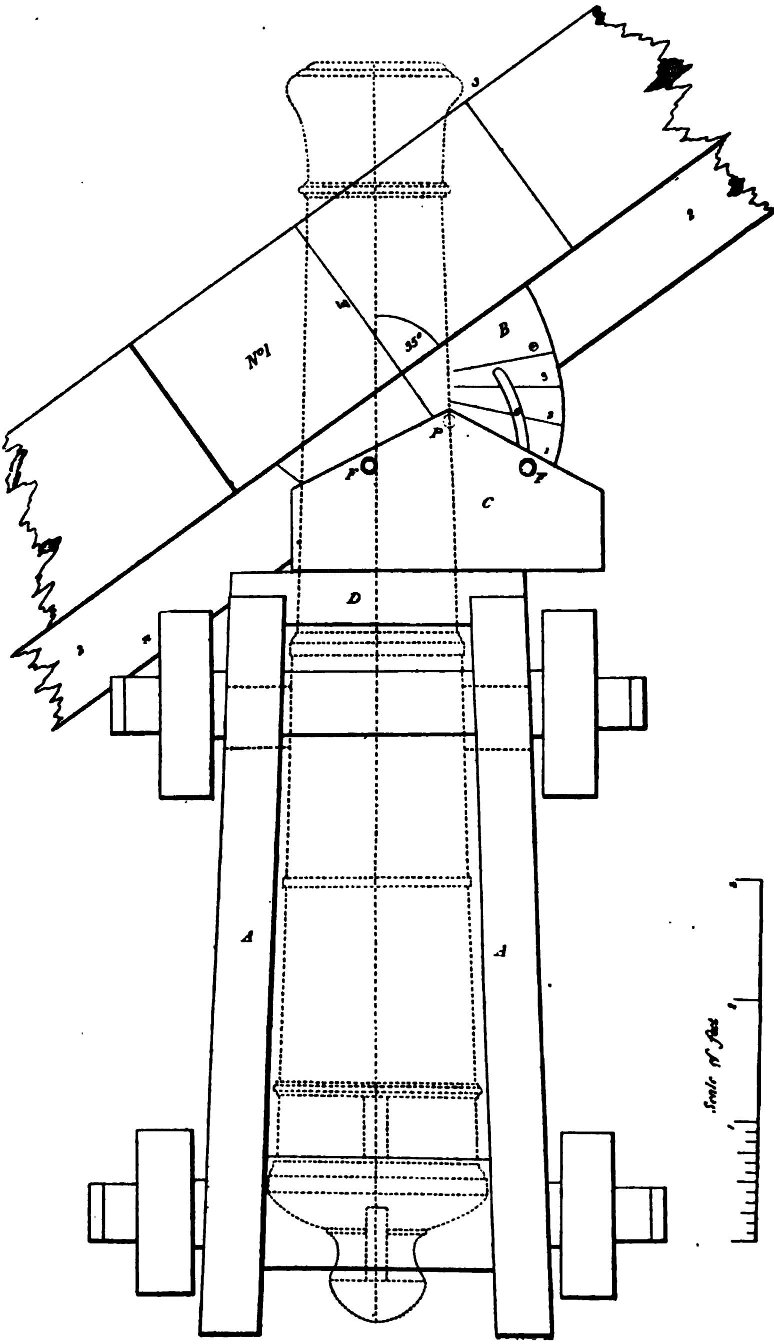


FIG. 2.—Breast-Piece for Securing the Desired Angle of Train.

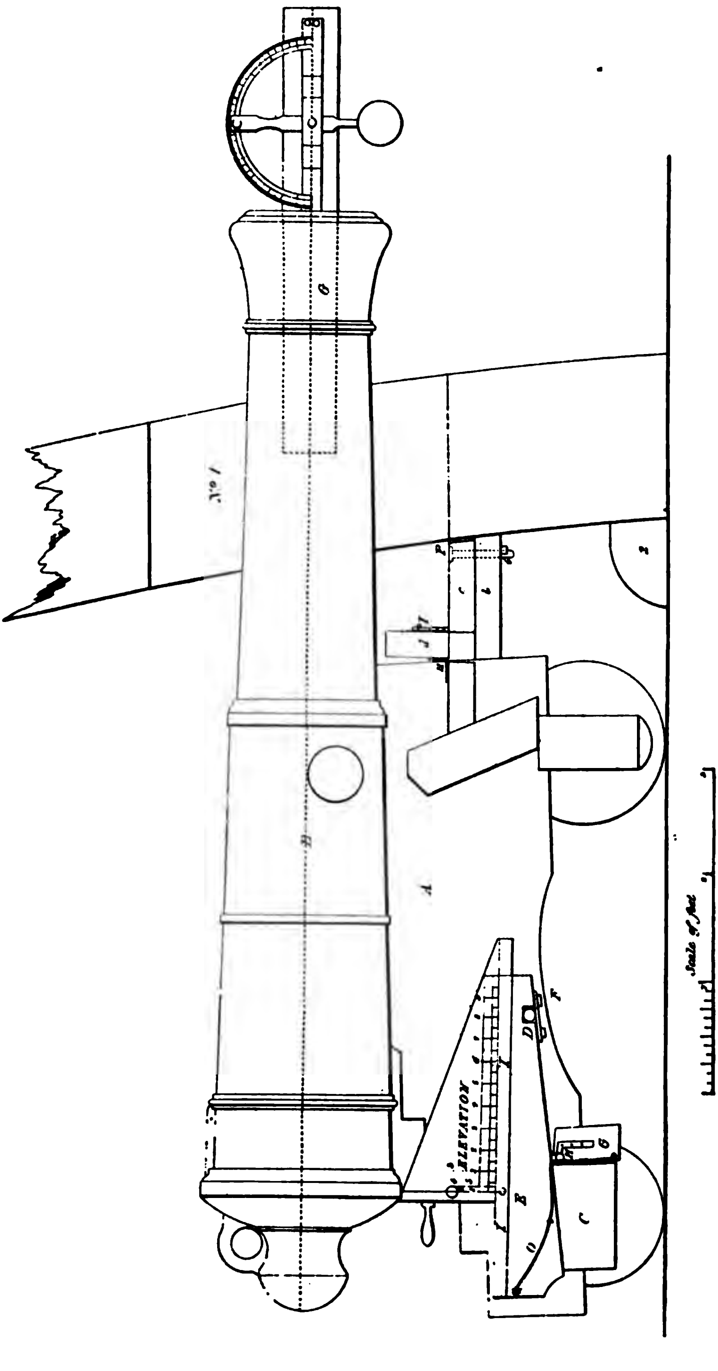


FIG. 3.—Bed and Quoin for Laying Gun to Required Elevation.

directing the fire. This device, which corresponds to our director or directorscope, Kennish named the "marine theodolite." (See Fig. 4.) It is worth noting that it included a *telescope, fitted with*

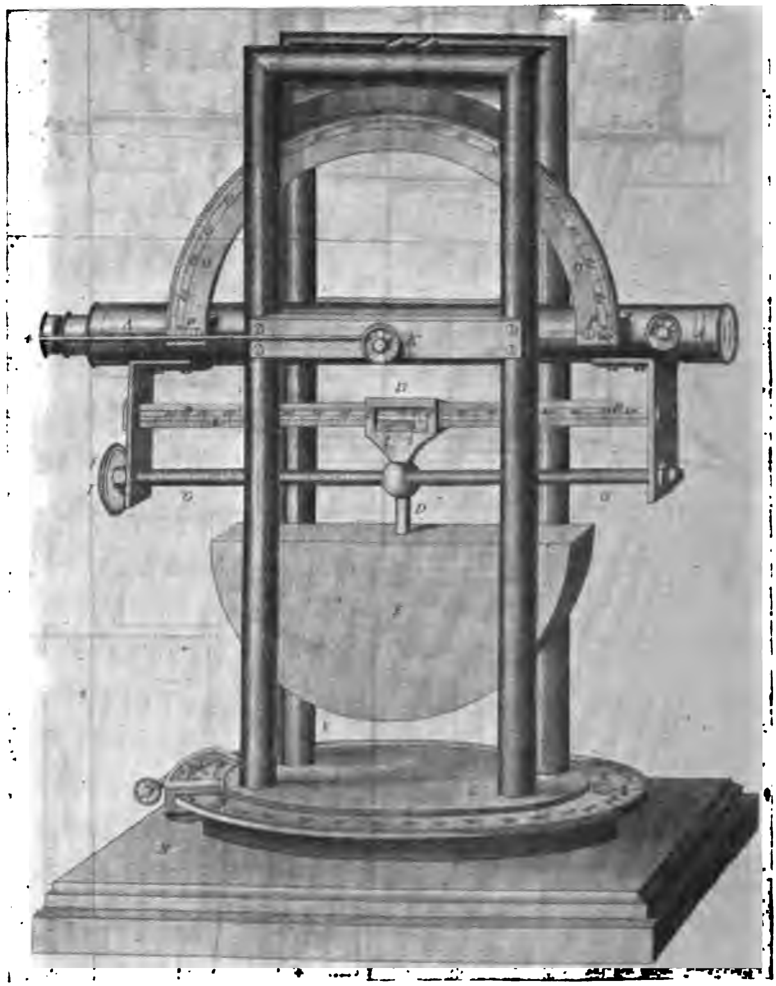


FIG. 4.—The Marine Theodolite. The Forerunner of the Modern Directorscope.

crosswires. Mounted on the hammock netting at the fore part of the poop-deck this theodolite was used to measure both the bearing and the range of the enemy, and to indicate the proper

instant for firing. The range was obtained by measuring the depression angle to the enemy's water-line, or the angle subtended by his masthead height, and consulting prepared tables for the corresponding distance. Then the proper fire number was sent to the battery, where breast-pieces and quoins were set accordingly. The helm was conned by the officer at the theodolite until the enemy was on the exact bearing. Then, upon the stroke of a gong, every lanyard in the battery was pulled, and a whole broadside of 32-pound shot would be on their way to land simultaneously at a single point on the enemy's water-line. Hardly a chance of failure to penetrate under these conditions!

In case of heavy rolling the theodolite was not used to show the instant for firing, because of the ballistic action of its pendulum, but was employed only for conning the helm. The range was measured by sextant angle, each gun-sight set for the corresponding "fire," and the pointer (who, in those days was the gun-captain) pulled his lanyard when his sight crossed the enemy's water-line. In other words, the system in a sea-way was director fire in train, pointer fire in elevation,—but firing "on the fly" instead of "steady on the bull."

Kennish first put his plan into practice on board H. M. S. *Hussar,* at Bermuda, in 1829, when he scored 3 hits out of 6 shots on a target 6 feet square at a range of 600 yards. Later, in H. M. S. *Galatea,* at Spithead, he met with even greater success. Upon a target of the same size, at the same range, a 10-gun salvo netted 7 hits. Then a 16-gun salvo completely destroyed the target, causing the captain of the *Galatea* to remark that "if a crow was standing on the target, its escape could only be attributed to a miracle." This same officer strongly recommended the scheme to the Admiralty, in an official report, not forgetting to mention the hypothetical crow; and several other officers of high rank also endorsed the plan. But either a less progressive régime came into power in the Admiralty, or else the service at large laughed the idea into the discard as a method impracticable for battle; for the system was never put into general use. It serves to show, however, that in naval gunnery, as elsewhere under the sun, there is nothing new.

DISCUSSION

Navy Yard Administration as a Problem in Industrial Engineering

(See Page 509, Whole No. 206)

Captain E. P. Jessop, U. S. Navy.—When one composes himself and honestly attempts to evolve an answer to such a question as "What is the matter with our navy yards?", he generally comes to the conclusion that there is so much which should be changed that it would be better to let "sleeping dogs lie" than to attempt an answer, and this is, to a great extent, caused by the primary fact that any answer will surely hurt the feelings of all who are strong corps exponents.

A recent article in these pages by a member of the construction corps manages to spread flaming darts of censure in various directions, many of them true, but many of them ill founded and therefore really dangerous.

It will not do to assume, as is done by the writer, that a graduate of the Naval Academy is untrained in the experience which tends to fit him for the position of industrial manager or superintendent in a navy yard, and that a civilian of equal age is so trained. Far be it from me to start anything, but when one views the dismal failures of dozens of civilians who stepped into high places in various government departments, and when one studies the bills which confront the nation due to these failures, one is led to suspect that there is more to the subject than a recital of the school at which a manager has been trained, or a glorification of the record he has made in any particular line of endeavor.

Several of the gentlemen who stepped to the front in the emergency, and who received the famous one dollar a year salary, had remarkable reputations in particular lines of activity, as managers, and yet were dismal failures in government service.

The Panama Canal stands, not as a monument to the civilians who were in control in the early stages of its construction, but as an example of the executive ability of the officers of the United States Army.

It is also a fallacy to assume that all successful corporations have efficient management. The writer personally knows several of the largest whose management is several degrees below that of the New York Navy Yard for instance, and which still make money sufficient to satisfy the directors and stockholders, and are considered eminently successful.

The hoary headed statement that a naval officer is not a business man would have died long since if the navy itself had not persisted in keeping it alive by repeated reiteration. Such modesty may be becoming, but it is sadly lacking in truth.

The truth is that naval officers, under the conditions imposed by regulations and statute law, are in the main better business men for the government than civilians would be in like position, and it is only that we appreciate that we cannot step out into the world and expect to immediately know all about business methods which are foreign to our train-

ing, and which, to put it lightly, do not savor of a strict application of the golden rule, or the commandments, which causes our modesty.

Organization is the art of arranging the personnel available so as to obtain the maximum standard output if the personnel does its expected work.

Management is the art of stimulating and coordinating the effort of the personnel.

Organization is mechanical, while management is eminently psychological. Such being the case any walk of life which trains a man in both of these arts continuously from the day he enters school to the day when he has reached his full mental growth, must be one from which organizers and managers can be drawn if training is the criterion upon which to base such selection. Such a walk of life is that of the sea-going naval officer.

From the day he enters the Naval Academy until the day when he steps on the bridge of a dreadnought as captain, he has been under training in organization and management.

During this time he has gone through all the grades, and his apprenticeship has been probably more intensive than in most other lines of endeavor.

In one respect he has had training far beyond that afforded by any other occupation; and that is in close association with men, and a daily example of applied psychology (the captain's mast) to assist in applying the finishing touches to his managerial education.

On board ship one is in constant touch with every one else on board, so much so as to make it difficult to keep one's occasional irritability from creating discord and discontent throughout the ship, for in such close association mental telepathy really is present. To prevent trouble one must get the habit of seeing the other fellow's side of things in a sympathetic and understanding manner, and what greater asset to the prospective manager can there be than such experience?

There is known to the writer no organization problem more exacting than the organization of the modern man-of-war, where in the last analysis the resulting effect must be that of automatic action where no two parts of the organization are in physical touch as it were, and yet team work must be perfect.

We have the word of the efficiency experts who were sent on board ship by the Secretary of the Navy to make suggestions as to improvement in ship organization and management, that the modern battleship represented the finest example of scientific management they had seen. An officer brought up in such an atmosphere must constantly absorb experience in management with his daily work.

Promptness, self-control, quick decision, ability to take responsibility, sympathetic understanding, organization, all are part of the day's work on the modern man-of-war, and one may search far to find any other occupation which approaches that of the naval officers in this regard.

One mistake is constantly made in theoretical discussions of the management problem, and that is the weight usually assigned to two elements, *i. e.*, technical training and practical training. Too much weight is usually given to the former, when the truth is that a practically trained man will frequently make a manager where the technically trained man without practical training seldom will.

Actual experience in the use of the output of an industrial plant would seem to be a requisite of the management of that plant if the output is to be kept practical and free from theoretical jimcracks.

Who is there among us who does not remember our astonishment at the frailty and inefficiency of our ordnance when we first began to really work the guns to their capacity?

Prior to the Spanish War we had not been able to really use the guns. Money for target practice was not forthcoming, and instructions from the Ordnance Bureau not to monkey with the apparatus which it furnished were the controlling reasons for this situation. When we were at last permitted to go to work the changes found necessary were stupendous, and were much delayed by the inability of the shore-going element to appreciate that their much-admired mechanism could be subject to so many ills as the practical man on board ship insisted they were.

This brings us up to another fallacy which needs exploding. It is a habit of essayists to assume that the one place to learn practical things about industrial plants and their output is in those industrial plants. This is true only of those industrial plants which are distinctly manufacturing plants and it is distinctly not true of repair plants, in which latter category the navy yards must naturally fall.

It is even not true of manufacturing plants where responsibility is accepted for the amount of service the output is supposed to give the consumer.

The above-mentioned essayists assume that operating mechanism, engine driving, ship handling, or, in other words, the use of the output of industrial plants, teaches nothing of design and nothing of repair. They ignore entirely the fact that ships are not continuously within range of repair plants, and that ordinary service requirements impose on the officers and men of the ships a responsibility for carrying out the desires of those in authority regardless of casualties to ships and machinery. They forget that competition between ships forces constant studies in design and repair on these sea-going members of naval personnel, and that the reputations of the individuals of this personnel depend almost entirely on their attention to these studies.

They forget that the ingenuity necessary to reduce to a minimum failures in carrying out the desires of those who have the ordering of ship movements must increase immensely the ability of that same personnel to make suggestions, supervise, and make repairs to such equipment, and to assist in design looking to improvement in practical operation.

They must be reminded that improvement in design is, more often than not, initiated and forced to adoption by these men who have to make the mechanism placed in their hands do the work for which it was built.

One is naturally inclined to wonder if constructors had been more consistently sent on regular tours of sea duty, more or less as line officers are, whether we would have gone on from 1893 to 1909 designing ships whose hulls required from 40 to 60 per cent extra horsepower to drive them at a given speed.

On this same line of thought it is noteworthy that the model tank is a practical, not a theoretical, proposition. It is the arrival at proper design, not by theory, but by practical trial.

There is yet another fallacy to be noted in Commander Reed's paper, and which is more or less prevalent in nearly all such papers, and that is the assumption that there is an essential difference between handling civilians and handling enlisted personnel.

It is true that civilian employees have affiliations in the form of unions which enlisted men have not, and it is true that, *en masse,* they form a problem a bit different from that of enlisted personnel, but individually they are exactly the same and are just as responsive to treatment as the enlisted man. They can be made restive by improper handling, or they can be made contented and satisfied by proper handling. The human element is not changed one iota by the clothes they wear. As far as the union question is concerned I cannot see that any one is particularly successful in solving that part of the problem, and, due to his experience in rubbing shoulders on board ship with men, I cannot see but that the seagoing line officer has as good a chance as any one of success in this solution.

I note the statement in Commander Reed's paper that the Naval Academy graduate ranks in technical education just behind the junior in a high-grade engineering school. That statement is probably true as far as it goes, but if the Naval Academy lives up to its reason for being, that same graduate has so much more training in handling men, in executive ability, in self-control, in fact in all other things that go to make up a good executive, that he should to my mind be a much better risk on the average for an industrial plant to take than the average graduate of a high-grade engineering school.

With regard to the selection of line officers for industrial jobs, or rather the stated lack of such selection, and the stated care in selection by other corps for such jobs, primarily that might be placed in the category of poor administration on the part of the line bureaus, rather than a demerit to the industrial ability of line officers, if such a lack of selection of line officers really seriously existed, but I cannot take the example set forth in the essayist's paper as a true indication that such is really the case to a serious extent.

I am, of course, not certain that the essayist's example included the below-detailed case, but it is not without the bounds that it did.

A young junior lieutenant came to one of our largest navy yards direct from sea for his first shore duty, he having been about six years continuously on sea duty, two years as passed midshipman and four years as ensign and junior lieutenant.

During this sea service he had spent the major part of his time on destroyers and the latter part of the time as senior engineer of a destroyer whose engine equipment was such as to make it a nightmare to try to keep her running. Due to the weakness of the engines this officer had spent quite a bit of his sea service at various industrial plants having repairs made, and due to his lack of rank his association was much closer with the foremen and mechanics at these various yards than might have been the case if his ship had been a battleship and his rank correspondingly higher.

The responsibility which he carried at all times at sea for keeping his machinery running made him follow up his work with more zeal than

might have been the case if his machinery had always been dependable and the repairs were only minor.

After a year as assistant outside superintendent he became outside superintendent, and no one who followed his work for the remainder of his tour on shore would have questioned a statement that he was everything that an outside superintendent could be desired to be. His ability to get work out of the civilian personnel was a direct result of his personal and close association, not only with his enlisted personnel on board ship, but with the employees of the various industrial plants where his vessel had had repairs made. His knowledge of repair work had been driven into him by the force of the necessity of keeping his machinery going in spite of obstacles which would have seemed almost insurmountable if viewed in the abstract, and it is this last experience which such essayists as the one under discussion constantly and one might say persistently ignore.

To the uninitiated his selection, as a junior lieutenant on his first shore duty, as outside superintendent would seem as indefensible as it appears to have seemed to our essayist, but a better man could not have been found, and those who chose him knew it.

One cannot say that because a naval officer has never been on duty at an industrial plant, he has never had any industrial experience. Industrial experience consists both of manufacture and use of equipment, and the latter is of more use as far as experience goes than the former. Every machine turned out by a manufacturing plant of reputation is presumably perfect in that manufacturer's eyes, but it is the individual who uses that equipment who knows how perfect it is and who can usually assist the manufacturer in making changes which add to its efficiency.

There is an idea prevalent that sea-going officers take shore duty to loaf. Nothing is farther from the truth.

Naval officers of standing are given their standing by the most severe critics in the world, their own cloth, and the one thing a proper naval officer covets above all others is the approbation of those of his cloth.

A loafer is card-indexed by service opinion, and while tolerated on account of the difficulties in getting rid of him, yet as far as the service is concerned he is not wanted around.

Shore duty for the sea-going officer is a necessity both on account of the mental staleness which becomes pronounced by too long continuance at sea due largely to the fact that one on board ship is always on duty and never away from his office and associates, but also to round out his experience in gaining a more intimate knowledge of the equipment which he uses, and to assist by his experience in improvement in that equipment. Seldom will it be found that an officer will try to get out of a good professional assignment on shore on account of the amount of work attached to it, and it will usually be found that the officer is desirous of taking the biggest job available regardless of its strenuosity.

To relegate the sea-going officer to those assignments on shore which are just paper-work offices, having nothing to be learned in them and where endeavor to excel would be out of place, seems to me to be almost immoral, and certainly such duty would dull the edge of the professional pride of most of us, and in a service where esprit is so essential it would surely work havoc.

Unfortunately, we have had one experience with the side-tracking of the line of the navy as far as shore duty is concerned, and our experience taught us that it was not only not efficient, but it was not even decently done. The writer can still remember calling on the engineer officer of a navy yard and finding him in a little room by himself with no clerk, no messenger, no files, and no authority, and yet that officer had had more years of industrial experience than any one else attached to the plant, was an engineer of excellent reputation in the service and of great experience, and as far as I could see his one item of authority and duty left was to act as surveying officer for worn-out or obsolete material turned in from ships. Such a system could not but kill itself, which it fortunately did in short order, but we want no more of such squabbles.

With regard to the assumed intolerance of the young line officer, especially toward his fellow of the staff corps. Intolerance is the mark of youth, whether of line, staff, or civilian. One does not change human nature by clothing it in various garbs. It can only be changed in this particular by the mellowing effect of years and experience.

Certain kinds of experience have a quicker effect, however, than other kinds in this mellowing process, and I am willing to place seafaring up as a target to be shot at by any industrial experience as to relative mellowing effect.

Apropos of that I was once in command of a ship in which some changes in quarters were being made. An approved blueprint of the changes was brought to me by a foreman in the construction department, and I suggested a change which made the cost one-half and naturally required much less time when time was a great element. The foreman returned from the planning superintendent with the word that if I wanted any change made I would have to see him.

That young man was just 30 years old and had not yet reached the age where the mellowing process usually begins. It seems needless to say I did not see him and yet the changes were made.

We cannot, therefore, admit that the young line officer is more superciliously inclined than his confrère of the staff corps of like age and experience, and in fact he may escape a little of that of his running-mate in the construction corps due to the fact that line officers are "not taken from the top of the class," the young constructor therefore having farther to fall than the young line officer to reach the level of true perspective.

That his training tends to make the young line officer "cock sure" and arrogant is another assumption which needs some discussion.

The writer knows of no parallel in the industrial world to the constant repression under which the young line officer is trained, nor does he know any parallel in the industrial world to equal the constant observation and criticism to which the young line officer is subjected. That the young man learns early to take responsibility is quite another affair and not to be confused with "cock sureness" or arrogance. Experience in taking responsibility is one of the most necessary adjuncts to the training of youth, since it is only by feeling responsibility and practicing shouldering it that the acceptance of responsibility becomes not a thing to be dreaded, but the natural part of the business in hand; otherwise, we would all be

trained "buck passers," of which commodity I think the staff corps own their full share if not more.

There has been much argument with regard to the attitude of the line toward the staff, and it may be that this is just as opportune a time as any to try to state the line position on that subject.

The line believes that at sea the staff officers are accepted on exact par with the line officers by the commanding officer and the executive and those others who from time to time have the ordering of things on board ship. The support they are given in their own particular work is usually greater than that accorded to the corresponding line officer, because the work of the staff corps is a specialty which the captain trusts his staff man to know better than himself, whereas the captain knows the line officer's job, or thinks he does, from A to Z, and therefore he is not so easily satisfied.

On shore the situation is a bit different in that the line knows, or thinks it knows, by antecedent probability, what would happen if the constructors got entire control of the shore plants, or in other words the non-seagoing element got entire control of the building and repairs to the equipment with which we sea-going element are going to attempt to beat the enemy.

Our ships, guns, and engines in '98 were monuments to the iniquity of the corps system. We had the construction corps building our ships, the engineer corps build our engines, and a practical ordnance corps build our guns, for, while the officers in the Ornance Bureau were line officers, the bureau was a self-perpetuating closed organization with good press agents, but with little more consideration for the murmurings of the real sea-going element than that shown by the regularly organized corps. Who has observed the wounded bird effect of the *Massachusetts* class, with turrets trained abeam, and not said, "From such as these Good Lord deliver us"? Who of us of the requisite age but remembers the almost mathematical certainty with which we would drop a ship or two on even the shortest of cruises in those days when our whole battleship fleet could be counted on the fingers of one hand, and who of us has forgotten the deplorable conditions we unearthed in our ordnance the minute we began really to use the guns as they should be used?

It must be borne in mind that I have not said all this was the fault of the individual corps who had charge of furnishing these various adjuncts of the fleet, but it was distinctly the fault of the corps system. Suspicion, jealousy, lack of knowledge of the other fellow's work, no common objective, everything in fact to disrupt and nothing to build up a working naval organization as a whole is what we got from the corps system and the line therefore looks askance at the attempts to oust them from a position where their voices will have proper weight in the design, repair, and general up-keep of the weapons which are destined to be put in their hands in war to be used against the enemy, and where mistakes of equipment for which they are in no way responsible will be registered against them and not against those who would not listen.

The line also remembers what happened in 1908-1909 and that has made them suspicious of any one who approaches them with fair words and promises while gently easing them toward the door. The line has always

admired the staff corps for their ability with both tongue and pen in discussion, and is much in the same boat as the master mechanic who, at the end of a dressing-down administered rather vehemently and at some length by his chief, said, "Well, chief, you talk better than I do." You will have extreme difficulty in convincing the line they are not interested in the building and repair of the equipment they use to a much greater extent than any staff corps and to such an extent as to require them to keep a controlling hand on such building and repair, and you cannot convince them that the experience they gain by the use of this equipment is not an offset to their supposed lack of technical training.

In fact, the line has never realized what terrible dubs they become, due to their sea-going habits. They have failed to appreciate that cruising about the world narrows them instead of broadening them; that handling men under circumstances where a slip or failure by one may mean disaster to many is not the right kind of training to teach the use of human material; that the operation of machinery teaches nothing of design, nothing of strength of materials, nothing of repair, and nothing to stimulate the ingenuity or the ability to suggest method.

The writer notes with somewhat of a sinking feeling that the poor old commandant, schooled on the Seven Seas, known to kings and diplomats, doctors, lawyers, engineers, and literary folk the world over, to use the words of the drunk to one who had never had the D. T.'s, "ain't never felt nothin', ain't never seen nothin', and don't know nothin'."

Conversely, the writer must admit that he had never appreciated what a broadening influence is possessed by the drawing board and the mold loft, or the shipfitter's shop overlooking Sand Street.

However, this is a bit beside the mark.

The writer does not believe that all line officers will make good industrial managers, just as he does not believe that all constructors would make good industrial managers, but he does believe that the training of the line officer has more in it to develop latent ability in organization and management than that of the constructor.

This is, of course, only a personal opinion, but it is based on quite an extended experience on both the sea and shore end of this question.

Mention has been made earlier in this paper of the troubles due to the corps system, and it is believed that therein lies the essence of the trouble in our navy yards.

The construction, repair, and operation of equipment are much too closely allied and much too interdependent to permit the control of them by two separate organizations.

Jealousy, suspicion of motive, recrimination, and downright obstruction are the sure results of such an arrangement, and the consequent inefficiency cannot be avoided, and this without regard to the personalities involved.

Such being the case, what is the remedy?

Amalgamate the line and constructors, send constructors to sea as first lieutenants of ships, keep up the post-graduate schools, and our problem is a long way toward solution.

U. S. NAVAL INSTITUTE

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ANNAPOLIS, MD., June 15, 1920.

INFORMATION INDEX

PROFESSIONAL NOTES

PREPARED BY

LIEUT. COMMANDER H. W. UNDERWOOD, U. S. NAVY

GENERAL ARRANGEMENT

FRANCE

FRANCE'S NAVAL OUTLOOK.—So far as eloquence can contribute to the building up of sea power, the French naval outlook is eminently satisfactory, practical unanimity having been reached as to the fact that the republic needs a strong fleet, and has the industrial means of creating one in conformity with the new data revealed by the war. Outwardly a purely defensive policy is advocated, and yet, in the light of the lessons of the war, it would require, to be successfully carried out, something more than 5000-ton scouts and destroyer and submarine flotillas.

Whereas the British Navy of to-day makes up for the reduced number of vessels in commission by the superior quality of the battleships and cruisers that fly the White Ensign in distant waters, the Gallic Fleet has come down to four battleships in full commission, namely, *Lorraine* (flagship of Adml. de Bon), *France, Courbet, Paris,* the other three dreadnoughts having only about two-thirds of their nominal complement, without scouts, and with only inferior destroyer flotillas! The 18,000-ton *Voltaires* and the 15,000-ton *Patries* are gradually going to rust and becoming unserviceable. Considerations of economy have just caused the *Justice*—formerly the crack gunnery ship of the fleet—to be disarmed and to be replaced by the ancient-looking and hardly seaworthy 8000-ton *D'Entrecasteaux,* that ploughs the sea with her terrible-looking ram at a rate of 11 knots in fair weather, as flagship of Admiral Laugier, head of La Division des Ecoles de l'Océan. On the other hand, a valuable personnel of officers and men is being wasted in the keeping in commission of *croiseurs-cuirassés* of 10,000 to 14,000 tons, carrying nothing above 7.6-inch weapons, and at the mercy of a single dreadnought, whilst some 30 gunboats of 700 to 1200 tons, parading as *avisos,* sloops, or *canonnières,* are swelling up the *escadres de la Méditerranée—poussiere navale* of the worst sort, essentially vulnerable and powerless, poor helpless sparrows which one hawk would frighten away and disperse. There can be no power where there is neither speed nor calibers, or the relative invisibility and invulnerability of the submarine or of the swift aerial mosquito.

This is expensive make-believe, and nothing else; and no wonder many *députés* are of opinion that at this time of the day the republic is really sacrificing too much to the mere pleasure of *jouer au marin*.

Growing dissatisfaction also is expressed with the shipbuilding policy. Outside of the narrow-minded maniacs of *la jeune école*, everyone now realizes the folly of losing the benefit of the £8,000,000 already invested in the hulls, armor, and motors of the half-completed *Normandie, Flandre, Gascoyne,* and *Languedoc,* especially since the lack of firmness and authority at the head makes it clear that some time will elapse before the cruiser program is taken in hand. The fifth unit of the quadruple-turret series, the *Béarn,* has just been launched at La Seyne, weighing 14,400 tons, and having been built up to the main armor deck. It is to be used as a tank, and the republic will boast of the possession of the most expensive fuel receptacle in the world. The British *Ansons,* the construction of which was given up, had not quite reached so advanced a stage, and it is fair to say that no other power, outside of France, would lightly discard powerful super-dreadnoughts of the *Flandre* and *Normandie* class, with over 14,000 tons of materials worked into them on the plea that something better may be forthcoming in some five or six years hence.—*The Naval and Military Record,* Apr. 28, 1920.

FRENCH NAVAL ACTIVITY.—Pending the Parliamentary debate that will decide the fate of the half-completed battleship program and of the naval policy of the republic, Minister Landry is making the utmost of the substantial credits placed at his disposal to safeguard the future, and in every manner pave the way for the *plus grande marine française de demain,* and no wonder. France has been saved by the sea power of Great Britain, and from all sides timely warnings come to her that in the future, still more than in the past, she will need to rely on the sea for her prosperity and security, for the preservation of both her situation in Europe and of her colonial empire. Of this necessity the Paris Chambers, that are being kept fully alive to the trend of European events, are getting every day more convinced. It is well realized, in the light of circumstantial reports made by well-posted agents in Germany, that the naval eclipse of the Imperial Republic of Bocheland is to be only temporary. "Where there is a will, there is a way." Now, the one capital point the war has taught the Huns is that there can be no hope of *revanche* for them, and of *Deutschland über alles* save in songs, without some degree of supremacy in the air and at sea, and it is no longer a secret that, while improving their supercannon designs and aerial craft, their experts are perseveringly and methodically making headway with the preparation of the naval armament of to-morrow, and it is believed that the enormous capabilities of Boche yards and inland factories, added to help from Russia and from neutrals, would enable them to put to sea in a very few years highly-efficient piratical flotillas, without mentioning the battle fleet they have been allowed to keep, no doubt modest enough on paper, but that will serve to foster the naval spirit and undiminished maritime ambitions of Mittel Europa. Such possibilities France can, no more than England, afford to ignore. Outmatched by Bocheland in the matter of population and numerical army strength, her only asset of victory in the case of a single-handed conflict would be the command of the sea and the advantage of safe communications with her colonies. And, of course, German represents for France the principal danger to be guarded against, as she is the only power in a position eventually to threaten the national existence of our republic.

Similarly, Italy is likely to reveal herself as a formidable rival in the no distant future. The war, by giving her the uncontested mastery of the Adriatic, has caused her to inherit the naval possibilities of the defunct Dual Monarchy, and made of Trieste and also of Genoa the chief ports of Central Europe. This coming economic prosperity will confer upon the peninsula the only asset which she lacked to attain naval greatness.

So, when is considered the go-ahead spirit of new Italy, it is safe to say that France will require to throw into the fray the whole of her assets and energy to win in the opening contest for Mediterranean supremacy.

These considerations, outside of the avowed determination of France to maintain her traditional position as the premier continental power, justify the well-thought-out ensemble of measures which the active Minister of Marine has adopted with a view to bringing nearer the day of our effective renovation. Personnel, bases, dockyards and gun factories, up-to-date armament, and all other factors not susceptible of improvization are being carefully looked after and calculated on a liberal basis, so as to remove all obstacles in the way of the realization of a first-class naval program.

Despite the vehement criticisms of the partisans of economy, no reduction is to be made in the personnel of *officers de vaisseau*, that was strengthened during the war by the addition of 330 *capitaines de corvette* and 200 *aspirants* and *enseignes*, nor will any diminution be made in the expenses devoted to the training of the 2200 active officers. The plea is that officers cannot be improvized, and that the cruiser and super-battle-cruiser squadrons of a few years hence must have trained crews ready to man them. The vital question of quality is not being overlooked: first, candidates to the *Ecole Navale* will have to satisfy hard physical tests and to be athletes, which is an innovation; and, second, bookish attainments and professional knowledge will have to be of a higher order than before, the war having shown the danger of improvized and untrained officers. Similarly, only the best class of seamen is to be kept in the service, and every effort is being made to add to the comfort of life on board, kinema appliances being part of the equipment of all craft of over 80 tons, and commanders receiving special allowances (some 2s. per man per week) intended for the well-being and entertainment of crews, either at sea or on shore. The lot of Mathurin has vastly improved since the Black Sea rebellion, and the number is steadily increasing of would-be recruits, which the navy is not in a position to welcome at the present moment for financial reasons.

Fleet bases that have been improved in some respects during the war are receiving further improvements with a view to enabling them to accommodate ships up to 300 meters length. Havre, St. Nazaire, Bordeaux, and Marseilles are all being considerably enlarged, and being fitted as auxiliary bases. New constructional facilities are being provided; the easy and quick transportation of Lorraine steel to the powerful Brittany arsenals is to be assured a few months hence, whilst constructional experiments with new types of hulls, of armor, of defensive devices, and guns are proceeding at Lorient, Ruelle, and Toulon. With the collaboration of Air Minister Flandin, the Toulon-Bizerta route, with a repairing base in Corsica, is being organized with trained pilots and reliable machines, and further developments are awaited that will place firmly in French hands the air command of the Western Mediterranean.

Whilst the French Navy may claim to have achieved some degree of superiority over all comers in the ballistic line, it lacks practical experience in the construction of modern cruisers, a sort of asset that is so overwhelmingly on the British side. Gallic constructors are second to none in theoretical attainments, no doubt, but the history of French naval architecture amply demonstrates that practice is necessary to give full value to paper calculations. Hence the importance of the studies and comparative experiments to be made in the war prizes *Kolberg* and *Novara*, through which Paris experts will gain some of the experience acquired by the German and Austrian constructional departments, especially as it has been decided to prepare, in addition to the 5200-ton *éclaireur* of the Leygues program, an alternative design reproducing some of the points admired in the British *Hawkins* and in the projected ocean scouts of America. Studies are also being made of fast seaplane-carrier designs, the *porte-avions* of the *Bapaume* class now attached to the Charlier battle fleet having proved

too small and too slow for aviation duties. At the same time, only short seaplanes, suitable for scouting and fire control, are to be carried on board. Heavy bombardment and long-range scouting machines will have Corsica and Bizerta as headquarters and train for their eventual duties in co-operation with the dreadnought squadron and flotillas. Moreover, the Paris Admiralty is closely watching the development of ultra-rapid *hydroglisseurs,* now being tested in the Middle Sea, that promise to be fair weather scouts of exceptional worth.—*The Naval and Military Record,* May 5, 1920.

GREAT BRITAIN

THE ANGLO-AMERICAN NAVIES.—There is a general consensus of opinion in this country that it would be ridiculous to attempt a rivalry with the United States in warship building. Whether time will alter this view has yet to be seen, but it is made plain by the absence of a program this year that it represents the official policy. On the other side of the Atlantic, a member of the House of Representatives has just been explaining to his countrymen what the exact situation with regard to the Anglo-American Fleets will be when vessels now in hand are completed. The situation has not hitherto been explained clearly in America, and it is just as well that it should be realized on both sides of the Atlantic. The figures given by Mr. Britten are very fair, and will bear the test of examination, but in his deductions therefrom he assumes that we shall not put in hand any new ships between now and 1923, and also that the Americans will complete all their new ships in a period which they have not always attained in the past, and which will be increasingly difficult to keep to in the future. It has been said more than once in *The Army and Navy Gazette* that it is no business of ours if America wants to have a supreme navy. Each nation must decide for itself what degree of protection it will provide, and a power with a long seaboard on two oceans has a correspondingly greater need for ships. But just as we do not question America's right to add to her navy, so we cannot for a moment admit her right to question what we may decide to be essential for us, to whom sea-power is more vital than to anybody, and Mr. Britten's remark quoted below about our bonded indebtedness—incurred as much in protecting Americans from tyrannical aggression as ourselves—is neither generous nor just. In order that the facts he has brought together may be better appreciated, it is as well to summarize them herewith:

"During 1916 to 1918 the United States has made tremendous strides in battleship authorizations, with the result that 1923 will see the American Navy the predominant naval power of the world, and capable of defeating the navies of any three nations combined, excepting Great Britain.

"Beginning with the *North Dakota, Delaware* and *Utah* (leaving out the *South Carolina* and *Michigan* because of their light tonnage, although they carry eight big guns), I find that we have 33 battleships and battle cruisers built and building, all of which will be available for service in 1923, while Great Britain has 35 first line ships of the same character, thus giving Great Britain an advantage of two ships, which we immediately offset by greater tonnage, bigger guns, superior muzzle velocity, heavier armor and more modern construction. The American ships have a total tonnage of 1,118,650 tons, against the British 884,100 tons, showing superiority of 234,550 tons, or an advantage of 8,638 tons per ship. In average speed of all vessels we are practically the same, showing a fraction less than 23.7 knots average per ship. In main batteries we have 340 guns to 314 for the British, with an average of 10.3 big guns per ship, to the British 8.97 guns per ship, while our guns will average 14½ inch, against the British 13⅔ inch, and this would appear to give us a tremendous advantage in weight of steel thrown by one broadside, when we will hurl 548,400 pounds against 452,000 pounds by all British big guns. Our ships will average 16,618 pounds of projectiles against 12,914 pounds for a

British broadside of main guns; thus our ships will throw 3704 pounds more steel than the British, ship for ship, or 28.7 per cent superiority."

Comparing the secondary batteries, Mr. Britten says, "Our navy has the greater advantage. Our 494 guns in this class average 5.4 inch caliber against the British 526 guns with an average of 4.9 inch, showing our guns to average larger in caliber and power, throwing 40,158-pound projectiles, against 32,080 for the British secondary battery, which means that our ships will average 1216½ pounds against 916½ pounds for the British), or more than 33 per cent to our navy's advantage. Great Britain has 350 destroyers built and building" (continues Mr. Britten), "while we have 322, but ours are larger, faster and more modern, and it is not unreasonable to assume our superiority in destroyers is even greater than in first line battleships and cruisers. In submarines England has 150 built or building, and we have 150 built or building. Great Britain has but one superdreadnought of the *Hood* type, of 41,200 tons displacement, with a 31-knot speed, carrying eight 15-inch guns; which is in no direction the equal of our *Indiana* type of superdreadnought of 43,200 tons, 23-knot speed, carrying twelve 16-inch guns.

"During the past twelve months Great Britain has dispered the material of at least one sister ship of the *Hood* class in the interest of economy, and I maintain that until she can pay interest on her bonded indebtedness, at least to her bonded creditors, she would not be justified in going ahead with a costly competitive battleship program, and particularly so not with us, when she realizes fully that we have no designs upon anything she may have. While the pride of Britain may be hurt by her slide into second place among the naval powers, she certainly cannot hope to successfully compete against us if we are really determined to take the place we are entitled to on the seas as the world's foremost nation, and where American commerce can receive the protection it failed to get prior to our entrance into the World War." In conclusion Mr. Britten declares: "The phrase, 'the freedom of the seas,' will mean just exactly what it says, and our supremacy thereon will never justify the control and regulation of the commerce of all nations merely because we have the power to do so, as Britain has done in the past, much to our disappointment and. at times, humiliation."—*The Army and Navy Gazette*, May 15, 1920.

SUBMARINES AND FUTURE NAVAL WARFARE.—The submersible commerce destroyer would continue to be of small dimensions, such as might easily carry four 6-inch guns. Concerted attack on trade vessels, in widely separated areas, should be guarded against, and trade vessels must either go under water or else move in convoy. The former method was not very feasible, and the latter would have to be the principal measure of defence.

"Speaking generally on submarine warfare, the lecturer thought that the advantages of the submerged ship were not likely, within ten years, to be so great as those enjoyed by the U-boats in 1914-16; and if methods of detection and under-water defence made normal advances, the tactical advantages of the submerged ship over the armed surface ship might in the near future be less than in 1919. Strategically, the advantages of submersion were great, and as constructional difficulties were overcome and it became possible to apply submersion to additional classes of ships without sacrificing other essential qualities, the strategic influence of submersible ships would increase to a corresponding degree. Whilst it would not pay to submerse the battle fighting ship, there were other classes of vessel in which submersion would be advantageous. Cruisers intended for observation work off enemy forts, or for watching enemy fleets, must be of the submarine type. Cruisers employed on screening and scouting duties, working with a fleet, will be of aerial and surface types, in co-operation. The commercial destroyer will be of the submarine type, whilst cruisers employed against these raiders must be of aerial and sub-

marine types, working in conjunction. The submersible minelayer would be useful in warfare against powers whose geographical position was such that inshore mine-laying would be profitable. For fleet action purposes the torpedo-carrying submarine will only be of marked use for covering the retreat of a defeated fleet.

"After the discussion of the paper, the Chairman, Admiral Sir Doveton Sturdee, indicated his agreement with the view that the submersible battleship was impracticable, as, with increasing size, the submarine became correspondingly more vulnerable. He also emphasized the importance of aircraft for reconnaissance and convoy work." (Lieutenant W. S. King-Hall, R. N., Lecture before the Royal United Service Institute, April 7, 1920; *The Times,* Apr. 8, 1920. 1 column.)—*The Technical Review,* Apr. 27, 1920.

BRITISH NAVAL STAFF.—The barony conferred upon Sir Rosslyn Wemyss was gazetted by the name, style, and title of Baron Wester Wemyss, of Wemyss, in the County of Fife. On October 16th, replying for the navy at the Cutlers' Feast at Sheffield, Lord Wester Wemyss defended himself and the Admiralty against criticisms in the press. Regarding the Admiralty, he said: "There is but one field of naval operations extending over all the world, namely, the sea. Moreover, by that immemorial tradition which obtains in all navies of the world, the naval commander-in-chief with his staff goes into action at the head of his forces. Thus it is impossible for a naval commander-in-chief afloat to be the center whence the strategical direction of naval war radiates. The result is that the Board of Admiralty, located in London, is necessarily the center whence radiate the executive orders as regards operations and movements of ships, and it exercises, as far as the navy is concerned, many of the functions of the military commander-in-chief in the field. These conditions necessitate a large and efficient staff organization. At the commencement of the war this, I am afraid, was lamentably inadequate, and it is only now that, with hard experience to guide us, we have reached a point when it can be truly said that there exists an efficient and admirable naval staff."—*Journal of Royal United Institute,* February, 1920.

NAVAL PRIZE MONEY DISTRIBUTION.—The commanders-in-chief of the Grand Fleet will each receive a thousand shares, or £2500; other commanders-in-chief, 850 shares, or £2125, if admirals; 750, or £1875, if vice-admirals, and 600, or £1500, if rear admirals. A vice-admiral will receive £1000; a rear admiral, £750; commodores vary from £1500, in the rare case of a commander-in-chief, to £400, with three intermediate graduations; and a captain in command will receive £400, £325, or £250, according to his position on the list of captains. A commander may receive from £150 to £75, a lieutenant about half as much, and so on down to £25 for a midshipman, or chief petty officer, £20 for a naval cadet or petty officer, £12 10s. for an able seaman, £7 10s. for a boy, and lastly, £5 for supernumeraries and the canteen staff.—*United Service Gazette,* May 6, 1920.

CURRENT TENDENCIES IN NAVAL DESIGN.—Of the many warships now under construction in the United States, the six battleships of the *Massachusetts* class are, in some respects, the most remarkable. Concerning the new battle cruisers, we may say, without risk of offending American susceptibilities, that they are slightly enlarged copies of H. M. S. *Hood.* Their bulge protection, however, is complete, instead of only partial, as in the British prototype; they are to steam at 33¼ knots, as against the *Hood's* 31 knots; their 16-inch guns fire a projectile of 2100 pounds, compared with the 1920-pound projectile of the *Hood's* 15-inch weapons; and their secondary armament of sixteen 6-inch quick-firing guns is superior in numbers and weight of fire. But, generally speaking, they present no novel features. It is otherwise with the battleships, which are distinctively

American in conception. The comparison, given elsewhere, of their design with that of the *Hood* brings out very clearly the great forfeiture of offensive and defensive power which high speeds involve. It will, no doubt, be urged that comparisons between warships of fundamentally different type are misleading, that for the tactical functions which the *Hood* is designed to perform, high speed is a *sine quâ non*. On the other hand, it is open to question whether the value of speed—tactically, if not strategically—has not been exaggerated. War experience has done much to modify naval views on this subject, as may be gathered from various passages in Lord Jellicoe's book, from the remarks made by Captain Sir Edward Chatfield at the Institution of Naval Architects last month, and from the writings and utterances of other distinguished officers. Captain Chatfield's words are particularly significant, for this officer, who served as flag captain to Admiral Beatty throughout the war and took part in every major engagement with the exception of the Falklands battle, is exceptionally well versed in modern tactics. Discussing the qualities of the *Hood*, he declared that those who had fought at sea had not found speed to be the most important feature in a warship. The main idea underlying superior speed was that it enabled the captain of the ship possessing it to choose the fighting range, but "that assertion is far from being true." Those who had been engaged in naval warfare knew, he continued, that the fighting range was largely determined by the weather. If the range of visibility was only 10,000 yards, it was useless to possess the speed and gun-power to enable the action to be fought at a range of 25,000 yards. "That case had happened over and over again." There could be no doubt, he added, that if new warships were to be designed to-day, British naval officers, at least, would not design another *Hood*.

If we rule out the British 18-inch gun, which is no longer mounted in any ship, the 16-inch 50-caliber weapon with which the *Massachusetts* and her sisters are to be armed must be considered the most powerful naval gun of the present day. Except that the projectile weighs 2100 pounds, and the muzzle energy developed is about 115,000 foot-tons, nothing is known of the ballistics of this piece. Provided, however, that the mountings permit of the requisite elevation, it should certainly be able to outrange both the 14-inch and 15-inch pieces carried by contemporary battle-cruisers, and in that case the superior speed of the latter would be useless except as a means of escape from the crushing salvos of the slower ship. And when all is said, capital ships, be they battleships or battle-cruisers, are primarily built to fight, not to fly. There are indications that the naval world is readjusting its ideas as to relative values of armament, armor, and speed. We have lately heard more than one authority recant his pre-war belief in the supreme value of speed. Naval opinion, both here and in the United States, appears to be crystallizing in favor of an ideal type of capital ship comparatively moderate in speed, and, therefore, *mutatis mutandis*, in displacement, but embodying the maximum degree of hitting and resisting power possible within the limits of that displacement. That we shall ever revert to the displacements of the pre-dreadnought era is practically out of the question, for big guns and thick armor necessitate generous dimensions, quite apart from the increase due to high speed. But it is possible that the capital ships designed a few years hence will be considerably smaller than either the *Massachusetts* or the *Hood*. If it be true that the leading authorities on both sides of the Atlantic have come to the conclusion that high speed is not a prime tactical necessity, and that its possession in no way compensates for inferiority in armament or protection, the way is already open for a large decrease in the size of capital ships. At the same time, we are not over confident that the opportunity will be seized. The constructor, encouraged by the naval officer, will assuredly be tempted to turn the weight saved by reduced engine power to account in some other direction rather than content himself with a smaller

ship. He will go on adding to the number and caliber of the guns, or to both, and to the thickness of the armor protection, until the margin of surplus weight is quite swallowed up and a ship larger than ever results. And when that stage is reached it is possible that high speeds may again come into favor, in which case a further huge jump in dimensions will become inevitable.

We would like to add a word of protest against the practice of comparing the resisting qualities of pre-war British and German capital ships to the exclusion of other features. It is true that the German ships were better able to withstand punishment, above and below water, than our own, but the cause of this discrepancy was strategical rather than technical. Germany as has since been admitted, planned her ships mainly, if not solely, for the purpose of fighting a North Sea campaign. They were never designed to make long cruises or to accept battle in waters remote from the German Bight. They were, in effect, very large coastal ironclads, in designing which it was not necessary to waste much space on living accomodation, since their officers and men were intended to spend most of their time ashore, and an unusually large percentage of displacementt and area could therefore be devoted to armament and protection. Our ships on the contrary, were designed in accordance with the navy's immemorial tradition of ability to cruise and fight in any quarter of the navigable globe. Consequently the factors of habitability, hygiene, and comfort could not be ignored, as, broadly speaking, they had been in the case of German ships.—*The Engineer,* April 23, 1920.

NEW BRITISH AIRSHIP.—Airship *R-80,* built for the Admiralty, will be launched here in two or three weeks. She embodies the latest improvements in aircraft design, and it is stated that she could fly across the Atlantic with ease.

The vessel is 535 feet in length and 70 feet wide. Her lifting power is 38 tons. Four engines, each of 240 horsepower, will give her a maximum speed of 65 miles an hour. She will carry a crew of fifteen. Originally intended for war purposes, the gun platforms and fighting paraphernalia have been discarded that more accommodation may be provided for passengers. She may be used to carry tourists over the battlefields of France and Flanders.—*The New York Times,* June 4, 1920.

NEW TORPEDO-PLANES.—It was announced in November that trials had been carried out successfully with a new type of torpedo-plane, a development of that first employed by the British Navy in operations against the Turks in the Sea of Marmora in 1915. These planes each carry two 15-inch torpedoes. Asked on November 18, whether it was proposed by the Air Ministry to encourage the development of flying-boats as distinct from seaplanes, Captain Guest, who replied for the government, said that the reply was in the affirmative. Three different types of experimental boat seaplanes were on order, and one of the prizes in the British Aircraft Competition for 1920 was for a boat or float seaplane.—*Journal of the Royal United Service Institution,* Feb., 1920.

CONVERSION OF GUNBOATS INTO CARGO STEAMERS.—Eight gunboats of the *Kil* class are now being converted into cargo steamers by J. Samuel White and Co., Limited, East Cowes, I. W. Their names are the *Kilmelford, Kilmarten, Kilmuckridge, Kildavin, Kilmead, Kilmallock, Kilmore, Kildorry.* The majority of these vessels were built by Smith's Dock Company at Middlesbrough, and their dimensions are, generally, as follows: Length between perpendiculars, 170 feet; beam, 20 feet 10 inches; and depth moulded, 16 feet 6 inches.

The conversion is being carried out in compliance with British Corporation Rules, Class B. S., and the work includes the straightening of the stem—the boats are double-enders—and the building of a forecastle. All

are equipped with two boilers. The forward one has to be removed and the space adapted to a cargo hold. The existing triple-expansion engine will remain in its original position and will give a speed of about 10 knots.

The conversion allows for a deadweight capacity, including bunkers, of 650 tons, of which the coal bunker capacity is to be 80 tons. The forward cargo hold is to have a capacity of 23,000 cubic feet with a cargo hatch 38 feet by 19 feet, and the after cargo hold 5900 cubic feet with a cargo hatch of 22 feet by 11 feet. Two steel masts are to be fitted to each boat and a wood derrick having a 3-ton lift is to be placed at each mast. A cargo winch, 6 inches by 10 inches, will be fitted at each hatch.

Accommodation has to be provided for 19 officers and men in each ship. The crew will be berthed under the forecastle, and the side plating amidships will be extended to enclose the bridge space, where accommodation will be provided for the officers on the main deck, while the chart and wheel-house will be on the bridge deck. From start to finish the work of conversion will average about two months for each ship.—*The Engineer,* May 14, 1920.

TRIAL TRIP OF THE MOTOR TANKER "NARRAGANSETT."—The motor ship *Narragansett,* which has just been completed for the Anglo-American Oil Company by Vickers, Limited, of Barrow-in-Furness, ran successful sea trials off the Mersey on Tuesday last. The *Narragansett* is a well-equipped oil tanker of the following dimensions: Length between perpendiculars 425 feet, breadth 56 feet 8 inches, and moulded depth to upper deck 33 feet. She has a short forecastle, officers' accommodation amidships, and engineers' accommodation in the poop, the main engines being placed right aft. Built on the Isherwood system of longitudinal framing, and to the highest class at Lloyds', the vessel has been designed to carry a total deadweight of 10,500 tons on a 26-foot draught of water at a speed of 10½ knots. Her cargo-carrying capacity is about 9450 tons of oil of 0.90 specific gravity, and for power and bunker steaming purposes 750 tons of oil fuel can be carried in tanks placed fore and aft, so that they may be utilized for triming purposes.

The *Narragansett* is the first oil-engined vessel to be owned by the Anglo-American Oil Company, and the first ship fitted by Vickers Limited with their solid injection type of oil engine, designed wholly for commercial purposes. Judging by the results of the sea trials, which were in every way successful, the makers are to be congratulated, and have proved that solid injection of fuel as applied to oil engines acting on the four-cycle principle can be designed to suit mercantile work as successfully and economically as any other system of fuel injection now on the market. The use to which cast iron has been put for all the main castings, and the massive construction of the engines in general, are noticeable features of the design. The vessel is propelled by twin screws, the two sets of engines fitted each consisting of six cylinders, arranged in two groups of three, the common diameters of the cylinders being 24½ inches and the stroke 39 inches. Each set is rated at 1250 brake horsepower at 118 revolutions per minute.

Fuel injection is effected by means of a small four-throw pump placed to the left of the central position in the center of the engine, and driven by gearing off the cam-shaft drive. The oil is delivered at a pressure of 4000 pounds to the fuel-injection valves placed on the cylinder head in between the air inlet and exhaust valves, and enters the combustion space at a pressure of from 450 to 500 pounds, depending on the power being developed by the engine. The fuel-injection valve is driven by bell crank levers and push rod, spring controlled, off the cam shaft, placed at the top and front of the engines. The air inlet and exhaust valves are similarly driven off the same cam shaft. Lever gear is provided, operated from the starting platform, to cut out any fuel injection valves separately, and also to alter the timing and period of injection, thus controlling the

power developed. The air-inlet valves each take their suction from a short vertical standpipe, closed in at the top and fitted with a suitable number of narrow slots. The exhaust from the cylinders is led into a common pipe—one for each set of engines—suitably lagged and then passes up the funnel.

In the *Vickers* solid injection oil engine no compressed air is required for the combustion of the fuel, but for maneuvering purposes compressed air has to be employed, and a vertical steam-driven Brotherhood air compressor has been fitted which delivers air at 600 pounds pressure to a reservoir of ten steel bottles placed horizontally in the after end of the engine-room. On the cam shaft are mounted the cams in pairs, giving ahead and astern motions. Immediately above the cam shaft runs another shaft along the front of the engine, carrying the fulcrum levers driven off the cam shaft. These fulcrum levers are mounted excentrically on the shaft, so that by partial rotation of the shaft the levers of the inlet and exhaust valves can be lifted clear of the cams. Reversing the engine is effected by a second motor operated by compressed air and fitted with a dashpot cylinder containing oil. This motor rotates the fulcrum lever shaft, thus lifting the lever clear of the cam, and a further movement of the reversing lever slides the cam shaft in a fore and aft direction, thus bringing the astern cams into operation, when the fulcrum levers are lowered, and astern motion ensues. A small hand pump is provided for reversing the engine by hand. The first movement of the starting wheel controlling the compressed-air supply to the cylinders puts compressed air into all the cylinders; further movement of this wheel cuts off the air to the cylinders in pairs, and puts oil into the injection valves until all the fuel-injection valves are receiving oil and the air supply is cut off. The maneuvering qualities of the engines were fully tried coming round from Barrow to Liverpool and during the trials, the average time from ahead to astern being about 10 seconds and from stop to astern about 8 seconds. It will be seen that a considerable duty is thrown on the air-compressor pump to keep the air bottles supplied while the engines are being maneuvered. The engines have been run at as slow a rate as from 40 to 45 revolutions per minute, and probably this rate can be still further reduced if desired.

A sister ship, the *Seminole*, is now being built by Vickers Limited for the same owners.—*The Engineer*, May 14, 1920.

AUSTRALIAN SHIPPING PROJECTS.—If the plans of the Australian Government are carried out, in a few years' time the Commonwealth will have become a great shipowning community. The present intention is to order a dozen large liners, to be built and equipped in Australia, for maintaining a passenger and cargo service with the United Kingdom. Private firms also are planning a substantial increase in their tonnage, the Australian shipbuilding yards are being rapidly developed, and a project is on foot to make Sydney the largest coal and oil bunkering depôt in the world. Apart from the economic benefit that the empire as a whole would derive from the creation of a great Australian mercantile marine, such a fleet would inevitably give a powerful impetus to the cause of Imperial defence. The Australian people's concern for the protection of the ocean routes will increase in proportion to the growth of their maritime interests, and once in possession of a great shipping industry they will need no urging to make adequate provision for its safety. Already, therefore, we may be in sight of a natural and logical solution to the problem of empire naval defence.—*The Naval and Military Record*, April 28, 1920.

THE AUSTRALIAN NAVY.—The arrival of the *Anzac* and the five destroyers given to Australia by the Imperial Government has appreciably increased the striking power and efficiency of her torpedo flotillas. As compared with the six improved "River" class vessels of 26 knots, one 4-inch gun,

and three 18-inch tubes, the new Admiralty "S" type of 36 knots, three 4-inch guns, and six 21-inch tubes, show an immense advance, and are altogether much more effective units of naval strength. With the cruisers she had already obtained before war began, the submarines of the "J" type which we have given her, and the useful series of auxiliaries, Australia has now, so far as material is concerned, the makings of a fine little fleet. It is up to her ministers to see that the advantage thus obtained is not wasted. The present, of course, is a difficult time to deal with—a period of transition, when the lines of future policy are not easy to determine. According to a cablegram, Commodore Glossop, who has just relinquished control of the dockyard at Sydney, is reported to have said that the Australian Navy is being starved as regards money, bases, ships and crews, as the government is marking time pending consultation with the Admiralty on Lord Jellicoe's report. It should be remembered, however, that the British Admiralty has itself hardly yet formulated a fixed naval policy, and it is small blame to the Australians if they have not been able to do so, but they should take steps, nevertheless, to ensure that the existing fleet does not deteriorate while one is being thought out.—*The Army and Navy Gazette*, May 1, 1920.

JAPAN

JAPANESE ALARM AT AMERICA'S NAVY.—A paradox of peace is seen in "America's inordinate naval ambition" by some Japanese newspapers, which point out that even now America is the greatest naval power in the world next to Great Britain. It seems strange to the Tokyo *Taisho Nichi-nichi* that the country which took the lead in advocating the League of Nations and reduction of armaments "should tend to evince a chauvinism which is, to all intents and purposes, anachronistic." But at the same time this journal relates that President Wilson, regarded by himself and by others as "the prime protagonist of the world's peace," sent a telegram to his country from Paris during the Peace Conference "urging the carrying out of the second naval extension program of America, because if it miscarried it would weaken the position of the American delegates at the Peace Conference." In view of this fact, Japan thinks that "it is perhaps foolish to wonder at the navalism of America." The authority of the League of Nations has not only been lessened by the non-participation of America, but her navalism is a factor "positively destructive of that international arrangement," according to this newspaper, which proceeds:

"If militaristic egotism appeals to Americans, they are perfectly at liberty to adopt it. but if they think that military demonstrations are the shortest cut to the world's peace, they will be egregiously mistaken. It will be recalled that when Mr. Churchill, then First Lord of the Admiralty, proposed a naval holiday, this was not accepted by Germany, and that it only led to a keener competition in naval armaments. A similar taste of affairs is now to be repeated between America and the other Powers."

Having "wheedled" the powers into restricting their own armaments, this Japanese journal goes on to say, America is "assuming the position of an international outlaw," and it wonders what the feeling of the powers is with regard to the present attitude of America, for—

"It goes without saying that, if the present state of affairs continues, the powers will no longer apply themselves to the consummation of the League of Nations. Will they not try to secede from it immediately on the lapse of two years' term? Will the League not become so utterly futile that the powers need not take any particular trouble to secede from it? Will it be possible for us to remain indifferent in the face of unrestrained anti-Japanese movements on the other side of the Pacific and extravagant utterances of some Senators, which often amount to a challenge, and the naval program of America, the objective of which is the Pacific?

"We are prepared to support the reduction of armaments and the League of Nations from the depth of our heart, but in view of the above-mentioned circumstances, does it not appear that in the case of an emergency we shall find ourselves prevented by the League of Nations from taking defensive measures? If, as we think, such an impression is not unnatural, it may reasonably be assumed that it is shared by the other powers."

Duplicity is charged against America also by the Tokyo *Yorodsu,* which says that "while on one hand America is urging pacifism, on the other she is steadily extending her armaments," and it questions what America's intentions are. If her real intention is to "menace oriental countries, her lip pacifism is, it may be concluded, a means of deceiving the world." Russia once advocated a Peace Council and then greatly increased her armament, and the *Yorodsu* wonders whether America is following in her footsteps. It believes the Japanese Peace Society should demand that the Peace Society of America start a movement to check America's naval extension. If America abates naval expansion the Japanese Navy should do likewise, and "if this is done the Japanese people will be relieved of a burden and there will be everlasting peace in the Pacific." But—

"As America devotes the gigantic sum of 1,100,000,000 yen to enlarge her Pacific squadron, Japan is compelled, limited as her financial resources are, to spend 860,000,000 yen on naval aggrandizement. If America does not expand her navy, the extension of the Japanese Navy is of no use It is because of the American menace that Japan is compelled to enhance her naval strength at the cost of increasing taxes under which the people are miserably laboring. If the Japanese pacifists succeed in having the armaments of Japan and America limited by cooperation with their confrères in America, it will mean not only added happiness to the two peoples, but something more.

"The ex-Kaiser, generally regarded as an incarnation of militarism, spoke of pacifism for over thirty years following his accession, and thus concealed his ambitions. It was much like Taira-no-Kiyomori, who wore a priest's robe over his military armor. Pacifism on the surface cannot deceive the world, which will surely detect militarism beneath. It goes without saying that lip pacifism cannot insure the real peace of the world. We earnestly hope that the Japanese Peace Society will rise to the occasion and approach the Peace Society of America to cooperate for the restriction of Japanese and American armaments in the Pacific."

The Tokyo *Yamoto* is puzzled to know what menace causes America's fever of navalism, and it observes:

"It is true that the position of the British Navy has been made stronger through the destruction of the German Navy, but the preservation of naval supremacy is a geographical and traditional policy of Great Britain, and there is nothing new in it. Some say that the objective of the naval extension of America is the British Navy. We do not know whether this is true or not, but if it be true, Great Britain could not afford to sit idle; if America built one ship, Great Britain would build as many or more ships. There would thus ensue a similar competition between the two countries to that between Great Britain and Germany before the world war. There were various reasons for the war, but no one can deny that one of the principal causes was Anglo-German competition in naval extension. Before the war the world only had an armed peace which was chiefly due to the extension of German armaments. In a sense, it may be said that the war was waged to bring down the prime mover in armament extension. If America now takes the lead in extending armaments, the world will again be turned back to the days of armed peace. We do not necessarily urge that America should join the League of Nations, but we cannot help wishing that she will not open the ball for competition in armament extension. Some time ago, speaking in the House of Representatives, Admiral Rodgers emphasized the necessity of America having the world's

largest navy. It is to be hoped that such an opinion will not gain ground in America."

Of specific interest to some Japanese editors is the proposal to build ten high-speed scouting cruisers, and the *Chugai-shogyo* remarks:

"The American naval authorities lay special emphasis on the necessity of having a high speed for those ten cruisers, and it can well be imagined what is the objective of the American naval policy. Is it not an undisguisable fact that since the end of the war America has been trying to devote her efforts to the Pacific? Unlike the cruisers hitherto built, those now proposed are to be of a specially large type so that they can conveniently cruise oceans. These facts should be duly noted by all interested in the future of Pacific questions."

The *Chugai* then refers to fortifications in the Philippines and other islands and alleges that the American authorities are arranging for a strong naval base at Guam. This fact should be impressive to Japan, in the view of the *Chugai*, because the island is closed to the Japanese, and at the same time has close relations with the South Seas Islands, the mandate for which has been given to Japan. The *Chugai* thinks that now and in future Japan should have her eyes wide open to the extension or establishment of naval bases in the Pacific, which will surely follow the enlargement of the American Navy.

Line-Up of American and Japanese Navies.—The United States Navy Department at Washington reports America has already built 797 naval vessels of 2,160,613 tons displacement; that there are under construction 197 vessels of 1,105,161 tons displacement; and that there are authorized nineteen vessels of 24,580 tons displacement. Japan's Naval Attaché at Washington reports that Japan has built 157 naval vessels and a number of submarines of a total displacement of 672,930 tons; and that there are authorized 38 naval vessels and some submarines.—*The Literary Digest,* May 22, 1920.

NAVY ESTIMATES.—On December 30th there were published the details of the expenditure proposed on national defence in the new Japanese Budget, for the financial year 1920-21. The increased expenditure for national defence amounts to yen 99,000,000, the ordinary and the extraordinary put together. According to the new program, the extraordinary expenditure, amounting to yen 486,000,000, is to be voted for the army, but to be spread over fourteen years (1920-1933). For the navy, the extraordinary expenditure amounts to yen 863,000,000, to be spread over eight years (1920-1927), and out of this total the approximate amount of yen 160,000,000 (ordinary and extraordinary put together) is to be granted annually in the year 1921 and after.—*The Journal of the Royal United Service Institution,* February, 1920.

MISHAPS.—On October 25th the Japanese naval maneuvers, which were witnessed by the Emperor from the battleship *Settsu,* were marred by two serious mishaps. In the battleship *Hyuga,* in Tokio Bay, an explosion occurred, as a result or which a gun turret was blown into the sea, the gun's crew of fourteen being killed and about thirty injured. Earlier in the day the destroyer *Hamakaze* was swept by a great wave, which fatally injured her captain, Kawita, and also killed Commander Gasao, commanding the first destroyer flotilla.—*The Journal of the Royal United Service Institution,* February, 1920.

SEA POWER IN THE PACIFIC.—Many people in England have no doubt been surprised to learn that, according to American journals, there exists in the Pacific Ocean a "dire and ominous situation" for which "the activities and ambitions" of Japan are held responsible. As recently pointed out in these columns, no news from the Far East of a nature to justify such strong language has reached Europe, but it is possible that the United

States has better sources of information. On the other hand, newspapers opposed to Mr. Daniels are suggesting that this sudden discovery of a menace in the Pacific may not be unconnected with the far-reaching plans of naval expansion which he has been urging upon the American people. Propaganda, they point out, is difficult to carry on successfully without some clearly-defined object, and now that Germany is out of the way, and Congress has refused to be drawn into a naval competition with Great Britain, Japan supplies the only remaining argument likely to appeal to the American taxpayer. In view of the marked disparity between the naval forces of the two countries, it is scarcely credible that Japan would deliberately adopt a policy calculated to provoke war. But since the contingency is one accepted as possible by American service papers of standing, it may be of interest to examine the composition and strength of the two fleets which would be involved in a struggle for the mastery of the Pacific.

It was in August last that the newly-organized U. S. Pacific fleet, led by Admiral Rodman's flagship *New Mexico,* passed through the Panama Canal. In dilating upon the improved strategical position resulting from the presence of this powerful fleet on the Western coast, Mr. Daniels reminded the country that naval protection depends not only on the ships themselves, but on the naval bases and dockyards necessary for their maintenance. For the time being such facilities are quite inadequate, and it has consequently been decided to create a large naval base and dockyard in San Francisco Bay.

In spite of the departure of so many fine ships for the Pacific, the Atlantic fleet, commanded by Admiral Henry B. Wilson, is still a very powerful force.

The composition of the two fleets was not arranged without careful consideration of the tactical problems that will ensue whenever they combine for joint maneuvers. Each fleet is practically the counterpart of the other, possessing the same types of battleships, cruisers, destroyers, etc., in divisional units. The organization, we are told, has been so perfected that when at stated periods they come together, not a single fresh order will be necessary for all units of the Atlantic and Pacific divisions to act as one great fleet. At such times the supreme command will pass automatically to the senior flag officer. "This new organization," it is stated, "will increase the effectiveness of our naval forces, and practically double the field and extent of training in tactics and war problems. Each fleet is at all times within supporting distance of the other, and all the ships of both could combine into one fleet before an enemy could, in any important strength, attack either coast. The navy by this means not only protects each of our long sea coasts, but places a wall of steel round our ocean boundaries which produces a sense of security such as we have never enjoyed before."

Thanks to the Panama Canal, it is estimated that the two fleets could unite in either ocean within a fortnight, assuming that when the order came the Atlantic fleet was off the New England coast and the Pacific fleet at San Francisco. Irrespective of new construction, and counting only ships now available, the strength of the combined fleet would be as follows: 18 dreadnoughts, 11 pre-dreadnought battleships, 11 cruisers, 215 destroyers, and 30 submarines—with an additional 100 destroyers and 70 submarines is reserve. Its chief defect lies in the absence of any battle cruisers or fast light cruisers, though both types will be available in two or three years' time.

Compared with this gigantic force, the Japanese Navy is relatively weak. Reckoning only completed ships, it embraces the following: Five dreadnoughts, 4 battle cruisers, 7 modern pre-dreadnoughts, 7 light cruisers, 70 destroyers, and 20 submarines. There are many old battleships, cruisers, etc., additional to the foregoing, but they are too feeble to be employed in modern operations.

As regards new construction, the position is as follows:

	United States	Japan
Battleships	11	4
Battle cruisers	6	8
Light cruisers	10	34
Destroyers	12	77
Submarines	67	80

The figures for Japan are considerably higher than might have been anticipated, but they are vouched for by the United States Office of Naval Intelligence. Assuming them to be correct, and that all vessels now building in the United States and Japan will be completed within the next three years, the rival navies in 1923 will stand as below. All pre-dreadnoughts are excluded, excepting only the Japanese *Aki* and *Satsuma,* which are approximately equal in fighting value to the early United States dreadnoughts *Michigan* and *South Carolina*:

	United States	Japan
Battleships	29	11
Battle cruisers	6	12
Light cruisers	13	41
Destroyers	330	147
Submarines	166	100

Within the near future, therefore, the relative position of the Japanese fleet will be considerably improved, especially in regard to fast ships, and if such a force chose to avoid a general engagement it would be extremely difficult to bring to action. The large number of light cruisers which Japan is said to be constructing would prove a serious menace to American shipping in the event of a conflict, even though submarines were not used as commerce raiders. Japanese weakness in battleships and destroyers would to some extent be compensated by her geographical position. That she would adopt the suicidal course of sending her fleet to give battle in American waters is not to be thought of. On the other hand, the U. S. fleet would be sorely handicapped in its offensive operations by the lack of adequate base facilities for a large force in Asiatic waters, and by the necessity of transporting material to the war zone across seven thousand miles of ocean. The problems of strategy which American commanders would have to deal with would be complex and difficult to a degree, and without a very numerous force of light cruisers they might well prove insoluble. If, however, the struggle were prolonged, and the United States had time to mobilize its almost unlimited resources, the issue would hardly be in serious doubt. It is possible that the American papers which impute warlike ambitions to Japan are doing a grave injustice to the intelligence of the statesmen and people of that country.—*Naval and Military Record,* April 28, 1920.

PLAN FOR ELECTRIC-DRIVEN JAPANESE WARSHIPS.—The electric-driven warships of the American Navy are attracting the attention of all the navies of the world. These ships are greatly superior to the old steam engines.

Our Imperial Navy, wishing to apply this scheme to Japanese ships in the future, is now earnestly trying to make the engines. As it is not satisfactory to leave the investigation simply to civilians, the navy proposed an investigation expenditure of several million yen in the next year's budget and decided to make a serious study of the matter.

There are now two opinions for the method of study; one is to buy small special service vessels that are electric driven from America and the other is to buy only the engines. The method of study will be settled some way between the Military Technical Headquarters and each arsenal after the budget is approved by the Diet, but if Japan buys the engines only, it is

said that these engines will be arranged to our special service vessels of about 10,000 tons for trial use.

It is said that the Asano shipyard bought not long ago motors and generators of 5000 horsepower for about 30,000,000 yen from Sweden and they are planning to fit them to the 8000-ton class of ship which will be finished about the beginning of next year. It is said the result is attracting considerable attention from the navy.

England has said that she will decide on adoption or rejection of the electric drive after seeing the effect of the American Navy's experimental engines that are going to be fitted to five new battle cruisers which are now in the course of construction. (Translation from *Tokyo Nichi Nichi.*)—*A. S. N. E.*, February, 1920.

JAPAN'S MERCHANT FLEET.—Japan had 3059 steamers, totaling 3,043,165 tons gross, at the end of January, 1920, according to the latest statistics of the Department of Communications. Of these steamers, 2876, with 2,877,891 tons gross, were registered in Japan proper; 88, with 35,726 tons gross, in Korea; 27, with 7837 tons gross, in Formosa, and 68, with 121,711 tons gross, in Kwantung.

The same statistics show that at the date mentioned there were 38 owners of not less than 10,000 tons gross each, 35 in Japan proper and 3 in Kwantung. The largest owner is the Nippon Yusen Kaisha, with 97 ships, totaling 457,494 tons gross, followed by the Osaka Shosen Kaisha, with 78, with 308,680 tons gross. Next comes the Kokusai Kisen Kaisha, the new shipping company which was established last year by merging the partial interests of a number of shipping companies. Its fleet consisted of 31 steamers, totaling 165,228 tons gross.—*The Nautical Gazette,* May 15, 1920.

UNITED STATES

NAVAL POLICY

ADMIRAL FISKE ON NAVAL STRETEGY.—*Prudence Combined with Audacity Won War.*—Rear Admiral Bradley A. Fiske, U. S. N., former Aid for Operations, in an interview which appears in the *Providence Journal* of May 15, 1920, discusses the admonition by President Wilson to the officers of the U. S. Atlantic Fleet, in a speech to them in the summer of 1917, that they should "not stop to think about what is prudent for a moment, but do the thing that is audacious to the utmost peril of risk." The Admiral when asked whether he would have counseled daring with audacity in naval action in the World War replied as follows:

"Yes, if that is necessary with American naval officers, a suggestion that history denies. But, I would have urged courage, only with prudence and with preparedness, with a careful reckoning of the difficulties to be overcome. To have given other advice, to have suggested that prudence be thrown overboard, would in my opinion have been to urge the rashness that alone could have given victory to the foresighted and prudent German General Staff, and the Germans were prudent until desperation forced their unrestricted warfare. We see now what their imprudence did for them.

"Prudence combined with and restraining courage and sheer audacity won the war. The boldest, the most valorous naval action, without prudence, could easily have lost it and the Allied naval problem was such that prudence was especially necessary. The Allied naval problem was to maintain mastery of the seas first, mastery of the surface of the seas, to deny the German overseas communications, to make the blockade against them tight and to starve them into submission; and secondly, to obtain mastery beneath the surface, defeat the submarine and to maintain free communications over the seas for Allied transport.

NAVY DEPARTMENT—BUREAU OF CONSTRUCTION AND REPAIR

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—DEGREE OF COMPLETION, AS REPORTED MAY 31, 1920

Type, number and name	Contractor	Per cent of completion			
		June 1, 1920		May 1, 1920	
		Total	On ship	Total	On ship
Battleships					
43 Tennessee	New York Navy Yard	Com. 6/3/20		99.6	99.
44 California	Mare Island Navy Yard	92.4	89.1	91.8	88.
45 Colorado	New York S. B. Cpn.	49.1	38.3	46.9	34.5
46 Maryland	Newport News S. B. & D. D. Co.	74.	71.	72.	68.
47 Washington	New York S. B. Cpn.	45.6	33.3	44.4	30.8
48 West Virginia	Newport News S. B. & D. D. Co.	29.	11.	28.	9.
49 South Dakota	New York Navy Yard	11.6	4.1	10.5	3.
50 Indiana	New York Navy Yard	10.0	2.5	9.7	2.2
51 Montana	Mare Island Navy Yard	9.8	2.2	8.6	1.6
52 North Carolina	Norfolk Navy Yard	10.8	5.4	9.7	3.9
53 Iowa	Newport News S. B. & D. D. Co.	3.9	1.	2.9	....
54 Massachusetts	Beth. S. B. Cpn. (Fore River)	....	....	....	...
Battle Cruisers					
1 Lexington	Beth. S. B. Cpn. (Fore River)	.5	....	.4	....
2 Constellation	Newport News S. B. & D. D. Co.	.5	....	.4	....
3 Saratoga	New York S. B. Cpn.	.6	.2	.5	.2
4 Ranger	Newport News S. B. & D. D. Co.	.5	....	.4	....
5 Constitution	Phila. Navy Yard	.8	.1	.4	....
6 United States	Phila. Navy Yard	.8	.1	.4	....
Scout Cruisers					
4	Todd D. D. & Const. Cpn.	50.9	35.5	48.3	30.4
5	Todd D. D. & Const. Cpn.	44.9	24.3	42.1	21.1
6	Todd D. D. & Const. Cpn.	29.5	4.3	29.4	2.8
7	Beth. S. B. Cpn. (Fore River)	5.5	2.6	5.3	2.5
8	Beth. S. B. Cpn. (Fore River)	5.5	2.6	5.3	2.5
9	Wm. Cramp & Sons Co.	41.	....	38.	....
10	Wm. Cramp & Sons Co.	37.	....	33.	....
11	Wm. Cramp & Sons Co.	18.	....	17.	....
12	Wm. Cramp & Sons Co.	18.	....	17.	....
13	Wm. Cramp & Sons Co.	18.	....	17.	....
Miscellaneous					
Fuel Ship No. 17, Neches	Boston Navy Yard	77.	75.8	71.	68.9
Fuel Ship No. 18, Pecos	Boston Navy Yard	29.	16.9	27.2	13.4
Gunboat No. 21, Asheville	Charleston Navy Yard	99.5	99.5	99.5	99.
Gunboat No. 22, Asheville	Charleston Navy Yard	39.	29.	37.9	28.9
Hospital Ship No. 1, Relief	Phila. Navy Yard	85.	81.5	81.5	77.5
Amm. Ship No. 1, Pyro	Puget Sound Navy Yard	99.6	99.	99.5	98.8
Amm. Ship No. 2, Nitro	Puget Sound Navy Yard	97.	92.	96.	91.
Rep. Ship No. 1, Medusa	Puget Sound Navy Yard	46.	35.	38.	30.
Destroyer Tender No. 3, Dobbin.	Phila. Navy Yard	21.7	19.	17.9	15.
Dest. Tender No. 4, Whitney	Boston Navy Yard	....	....	....	....
Sub. Tender No. 3, Holland	Puget Sound Navy Yard	2.5	....	.6	....

There are, in addition to the above, 79 destroyers, 52 submarines, 3 oil tankers and 5 sea-going tugs in various stages of construction.

There were completed and delivered to the Navy Department during the month of May 6 destroyers, 1 submarine, 2 oil tankers and 1 sea going tug.

The *Tennessee* was commissioned June 3, 1920.

There are 12 destroyers, 7 submarines and 1 transport, authorized but not under construction or contract.

"With extraordinary skill and prudence the Germans prepared a nest for their submarines in shallow waters, building a first line of defense of mines, behind this hiding their submarines and supporting both these with their high seas fleet. The difficulties of navigating those waters by an enemy ignorant of the mines and of conducting naval operations upon any considerable scale within them were incalculable. A knowledge of what could be done and of what could not be done within that area was possessed by the experts of the British Admiralty, but it is hardly conceivable that any such knowledge could have been had by any man not personally and intimately acquainted with both the hydrographic and the military details of that area.

"It is probable that the Germans nursed the hope that their enemy would pursue that course of desperation, with prudence thrown to the winds. Had they done so, it would have profited the Germans more than the most successful conduct of the submarine campaign could have done. It would have made possible for the Germans the invasion of England and have left America with no dependable protection against the menace of the German fleet.

"It is to the prudence of the British Admiralty, standing firm against the advice to 'dig the rats out of their holes,' that the American people owe their protection against invasion."—*Army and Navy Journal*, May 22, 1920.

DANIELS DEPLORES CUTS IN NAVAL BILL.—Four "serious disappointments," which he does not believe the people of the United States will approve, are contained in the Naval Appropriation Bill, according to a statement by Secretary Daniels, made public tonight. The bill was recently passed by Congress, and was signed yesterday by the president.

Secretary Daniels lists these diappointments, as follows:

"1. The failure to make provision for adequate naval expansion on the Pacific, made imperative by the presence of the great fleet on the Pacific and the proper protection of that coast and outlying American islands.

"2. The failure to make even halfway provision for naval aviation.

"3. Failure to authorize the construction of a single new ship, appropriating only for the completion of the ships authorized in the 1916 program.

"4. Failure to appropriate sufficient money to repair and keep in condition ships which the Office of Operations told Congress were essential and ought not be deferred."

Failure to provide for these four naval needs, says the secretary, "is a matter for national regret, and in the debit and credit side will overbalance much good legislation and wise appropriations contained in the bill."

"The importance of naval development in the Pacific cannot be overestimated," continues Secretary Daniels. "Before the World War Congress directed a board of naval officers to make study of the Pacific needs. The Helm Board made one of the most comprehensive and wise reports ever submitted to Congress. Action was postponed until after the war. Last summer another able board, headed by Admiral McKean, made a study, and in my estimates request was made for the enlargement of Pacific bases. A special commission of Senators and Representatives has been appointed to visit the Pacific and report by December. I feel sure this commission will see the need of large provisions, but the delay is to be regretted in view of the acute situation regarding the question of bases and repair facilities on the west coast due primarily to the transfer to that coast of half of our effective fleet.

"The appropriation for naval aviation contained in the bill is only $20,-000,000. How can we lead in this greatest of modern agencies upon such a small appropriation? We will do all we can and make all the progress possible, but in the main we will be but marking time as to any daring and forward development until Congress has the vision to appropriate sufficient money to enable the United States to take the proper place in the development of air navies.

"Not only has Congress failed to appropriate sums sufficient for the needs of naval aviation, but it has attempted, through a clause inserted in the Army Appropriation Bill to limit the coastal and overseas activities of naval aviation. It is my purpose to appeal to Congress to reverse this action which is an unnecessary and unwise limitation upon naval efficiency in aviation.

"The General Board presented with able argument, a program of new construction. In view of the fact that work could not be pressed on battle cruisers and dreadnoughts during the war, I did not press the authorization for capital ships, but did urge Congress to make appropriations for destroyer tenders, aviation carriers and smaller scout cruisers necessary to round out the fleet. The department also urged most earnestly an appropriation of $11,000,000 for the completion and fitting out of seven vessels as aviation and destroyer tenders at the Hog Island plant of the United States Shipping Board. If this legislation had passed the navy would have obtained seven needed ships for $11,000,000, which, if built under other conditions at current prices, would cost $23,000,000.

"The total appreciation amounts to $433,279,574. In a speech in Congress, Leader Mondell stated that Congress had reduced the estimates $139,851,680.80. As a matter of fact the bill only postpones expenditures until after the election, and makes no reductions except at the cost of naval efficiency.—*The New York Times,* June 6, 1920.

MATÉRIEL

NEW U. S. ELECTRICALLY-PROPELLED WARSHIPS.—The new battle cruisers of the U. S. Navy are to have a displacement of about 44,000 tons, a maximum speed of 34 knots and fractional speeds at which the economy will be very high.

"About 180,000 h. p. per vessel will be obtained from four steam turbines each driving a 40,000 kva., 3-phase, 5000-volt generator at 1835 r. p. m. On each of the four propeller shafts there will be mounted two 3-phase induction motors of 23,000 h. p., running at 331 r. p. m. when operating with 22 poles. These motors will also develop 6800 h. p. at 170 r. p. m. when operating with 44 poles. The new battleships are designed for displacement of 43,000 tons, and require 60,000 h. p. to drive them at 23 knots. Each vessel will be driven by two turbo-alternators (22,000 kva., 2-phase, 5000 volts, 1800 r. p. m.) serving one induction motor on each of the foui propeller shafts. Each motor develops 15,000 h. p. at 225 r. p. m. with 16 poles, or 3600 h. p. at 150 r. p. m. with 24 poles, (*Journal, American Institute of Electrical Engineers,* Feb., 1920. Half column.)—*The Technical Review,* May 7, 1920.

MERCHANT MARINE

There were building in American shipyards on May 10, 1920, 188 merchant ships aggregating 977,488 gross tons.—*Shipping,* May 10, 1920.

SHIPPING BOARD'S VESSEL SALE POLICY.—The committee of representative business men headed by Eugene Meyer, Jr., and recently appointed by Rear Admiral Benson to recommend a definite plan for the disposal of

the government's merchant tonnage has just submitted its report and the same is now before the Shipping Board for action. When the administration decided that the government should not remain in the shipping business, the authorities at Washington were confronted by a dilemma. Were they to sell the federal owned merchant fleet now in excess of 9,000,000 tons deadweight at prices ranging from $100 to $125 per ton as urged by shipping interests, the transfer of this vast tonnage into private hands would have been undoubtedly facilitated, but the government would have lost heavily on its war-time investment in shipping. Furthermore, until the government's prospective merchant fleet of two thousand vessel units was absorbed by the investing public, our shipbuilders, who are asking in the neighborhood of $175 per deadweight ton for new cargo carriers, would not be likely to receive many orders. Low prices for the Emergency Fleet Corporation's craft meant, therefore, the prostration for the time being of the American shipbuilding industry and the writing off of a large percentage of the enormous sum invested by our government in shipping. On the other hand, were the Shipping Board to ask too high a price for its hastily constructed standard ships, vessel owners might be chary of buying them and prefer to build new craft specially designed to meet their particular requirements.

Faced with this situation, the Shipping Board while Mr. Hurley was still directing its affairs decided that the proper policy for it to pursue was to try to come out even. Accordingly it offered its ships at their actual cost price less all charges for over-head. This course of charging more for the vessels of the Emergency Fleet Corporation than their replacement cost was defended on the ground that the Shipping Board was alone in a position to deliver ships promptly and was therefore justified in asking more for its tonnage. It resulted, however, in very few of the government's vessels being sold and in intending purchasers holding off in the hope of lower figures being quoted later on.

More recently the Shipping Board has been offering its steel ships on the basis of an initial payment of only two and a half per cent of the total purchase price, plus a bare boat charter rate of $5 per deadweight ton per month. The income from this last-named source was to be applied on the purchase price. This low initial payment charter plan, which was discarded last week, possessed the drawback of making it easy for inexperienced parties, who had no intention of remaining permanently in the shipping business, to secure ships and to retain them until such time as their operation became unprofitable when they could be turned back to the government.

Differing from any plans heretofore pursued, the program of the Meyer Committee calls for the sale of the government's merchantmen on the basis of present reproduction instead of war-time construction cost. Prices for the different types of vessels are to be stabilized and present buyers of tonnage protected should the Shipping Board find it necessary to make still further price reductions hereafter. The committee's other recommendations are set forth on another page. Whether they will be accepted unreservedly by the Shipping Board is as yet uncertain. Even should they be adopted as presented, it is by no means assured that any great number of the government's ships could be sold on a reproduction cost basis. Before they can be disposed of on a large scale, it may prove necessary to quote considerably lower prices. The plan proposed by Mr. Meyer and his associates possesses this great merit that it enables the Shipping Board to vary the asking prices for its ships in accordance with changing conditions. It is for this reason much the best sales plan yet brought forward and we trust that Congress will not attempt to interfere with it.

Opponents of the policy heretofore pursued by the Shipping Board regarding the sale of its ships contend that it should have lost no time, when the armistice was concluded and while shipping profits were still abnormally high, in writing off a goodly part of the cost of its merchant fleet and in offering its vessel units upon attractive terms. Had this been done, many of its vessels would have been sold. Their new owners would have realized very handsome profits from their operation and would have been enabled to build up resources to carry them through any future period of depression. This opportunity to bring about a quick transfer of the major portion perhaps of the government's merchantmen was not availed of. The problem still remains of effecting their speedy passage into private hands. This much-desired object could be in a large measure attained if the plan of the Meyer Committee was adhered to, which makes it possible for American ship operators to obtain ships from the government at prices permitting them to compete with such foreign competitors as acquired their cargo carriers at pre-war tonnage valuations.—*The Nautical Gazette*, May 15, 1920.

U. S. AND BRITISH SHIPPING FIGURES.—According to Secretary of Commerce Alexander 15,800,000 tons of shipping are under the American flag at the present time, as compared with 19,800,000 tons under the British ensign. When the German tonnage is finally distributed pursuant to the terms of the Peace Treaty, Britain's shipping will be very much increased.

American ships to	Overseas clearances from United States: Calendar year 1919 net tons	Fiscal year 1914 net tons
Europe	6,010,148	447,667
South America	1,608,590	192,479
Asia and Oceania	860,160	100,833
Africa	131,328	4,263
Total Overseas	8,610,226	745,242

Foreign ships to	Overseas clearances from United States: Calendar year 1919 net tons	Fiscal year 1914 net tons
Europe	13,863,195	19,598,524
South America	1,359,620	2,237,180
Asia and Oceania	2,293,706	1,889,272
Africa	363,086	402,194
Total	17,879,607	24,127,170

All ships	Overseas clearances from United States	
Grand total	26,489,813	24,872,412

—*The Nautical Gazette*, May 15, 1920.

U. S. EXPORTS CARRIED IN AMERICAN SHIPS.—For the first time in many years a larger proportion of the ocean-going exports of the United States were carried in American ships than in those of any other nation. Of last year's total exports amounting to $6,952,284,572, 36.7 per cent were

carried in American bottoms and only 35.3 per cent in vessels flying the British flag. The following table shows the value of our exports in 1919 transported in the ships of various maritime nations:

Country	Value
United States	$2,549,641,908
Austrian	22,334
Belgian	102,936,289
British	2,453,710,913
Danish	140,606,725
Dutch	164,834,366
French	163,285,016
German	130,619
Italian	241,183,601
Japanese	359,844,178
Norwegian	401,373,116
Spanish	101,259,631
All others	273,455,828
Total	$6,952,284,572

—*The Nautical Gazette*, May 15, 1920.

AERONAUTICS

TORPEDO PLANES.—The subject of our study is limited to submarine automobile torpedoes.

Airplanes, or eventually dirigibles, may have three rôles with relation to them:

First, that of torpedo-launching vedette; second, that of director of dirigible torpedoes, whether launched by airplanes or not; third, that of reporting enemy torpedoes.

We shall proceed to elaborate these three services:

Torpedo-Launching Airplanes.—A torpedo is of very variable weight, according to its caliber and length. A modern torpedo, 450 mm. in diameter by 5.50 m. weighs 700 kgs.

An airplane lifting this weight having been realized, the conditions necessary for its launching must be taken up and examined. As the torpedo must strike the water in a nearly horizontal position, it is subjected to a considerable strain when the shock occurs; the airplane, therefore, should drop to a position near the surface in order to moderate this shock. The torpedo, which up to this point has been held by hands or hooks, is then released and dropped.

The torpedo enters the water at a speed about equal to that of the airplane, greater therefore than that which belongs to it properly, which creates new launching conditions.

The torpedo-launching airplane has been but little used during the war. The German Navy, however, made some experiments with it in 1916. Other attempts were made in England.

It is interesting to examine in detail one of these experiments, that of the Leeds Blackburd Airplane and Motor Company. The apparatus is to be transported by a vessel and make its ascent from the deck; it is therefore furnished with wheels. Moreover, as it must make its ascent over a very short run, articulated ailerons are provided; said ailerons are inclined for flight and afterwards efface themselves by assuming the same plane as the wings. The operation of the ailerons is controlled by the pilot after starting; to avoid the shock, an oil-break retards the movement which result is accomplished in 45 seconds.

The wheels which are used in getting off are detached later, the detachment being controlled by the same lever used for the ailerons.

Landing is effected, either on the vessel or on the earth, by landing props with slides which are seen in the picture. These tail skids are furnished with shock absorbers.

The apparatus can also alight on the water, the absence of wheels facilitating this operation. Air pockets placed in the fuselage help it to keep afloat, and wooden planes at the fore-part of the chassis raises the nose of the apparatus.

The torpedo is supported on its upper side by two half rings and held in place by a strap; to avoid its becoming displaced longitudinally, it is furnished with a guide which fits into a hasp in the lower part of the fuselage. The releasing of the torpedo is effected by the same lever that is used in operating the ailerons and in detaching the wheels. The two ends of the strap are freed at the same time as the starting lever for the torpedo is lowered.

The dimensions are as follows:

Spread	16	meters.
Space between the planes	2.10	meters.
Breadth	2.10	meters.
Height	4.25	meters.
Length	11.50	meters.
Wing section, Royal Air Force type, modified.		
Weight, with torpedo and fuel	2600	kgs.
Radius of action	5	hours.
Load per horsepower	7.5	kgs.
Load per dm. 2 of wings	0.4	kgs.
Rolls-Royce motor, 350 horsepower, water circulation.		

How can such an apparatus be employed? A submerged submarine may be more economically attacked, and more effectively, by means of bombs which can seek it out at various depths.

The advantage of the automobile torpedo is that it follows a horizontal course, throughout which it is constantly offensive; it is particularly interested when it strikes a vessel on the surface, and it is the only weapon which directly attacks the hull. In case of launching by airplane, particularly favorable features may be imagined. Airplanes, through their speed of attack, enjoy very great advantages, the time needed for descending to a launching position will be so short that even vessels actively on guard may be successfully attacked.

Torpedo launching from aeroplanes threatens to supercede torpedo launching from a great distance, which under present conditions of gun range may consume more than a quarter of an hour in its transit.

It may be necessary to devise a special model of torpedo to meet the launching conditions of airplanes, but this is not an objection which is deemed insurmountable.

The Airplanes as a Direction of Torpedoes.—With the launching of torpedoes by airplanes already in operation, we have only to consider now a plan not yet realized. The direction of torpedoes by Hertzian waves has reached such a state of advancement that we may consider the problem on the verge of being solved. Airplanes or dirigibles plainly constitute observatories from which these devices may be watched and directed. One of the greatest difficulties is the difference in speed between the airship and the torpedo; the directed torpedo seems to be an engine which probably will remain somewhat slow in action, and the maintenance of a high speed in immersion presents great difficulties for this type of apparatus.

Airplane for Reporting Torpedoes.—This operation necessitates no particular installation, as the observation of the trajectories of gas torpedoes in use at the present time may be easily accomplished for a high point

several hundred meters away. The knowledge thus obtained will not be of much service in case the torpedo is launched from a short distance, as time would be lacking in which to make use of it; but in case of a long range shot, the slowness with which the torpedo travels and the length of its course make it possible to utilize the information given by the airship, airplane, dirigible or captive balloon with great benefit. This is a factor to be considered when contemplating a long-range shot, which reduces the already remote chance of a successful result.—*La Revue Maritime,* January, 1920.

THE TORPEDOPLANE IN FUTURE NAVAL BATTLES.—Italy has always followed with the greatest interest the tireless efforts of the Aero Club of America to spur the American Government and the American public to undertake the building of torpedoplanes. The writer has had the honor of being repeatedly mentioned in *Flying* for having effected the first launching trials in Italy in the year 1912, and for having built, in 1913, together with Mr. Pateras Pescara, the first torpedo seaplane from which a 700-pound torpedo was successfully launched.

America, on the other hand, has Admiral Fiske, who has worked on similar lines. He was the first to patent, in 1912, the torpedoplane, and since that time has always had great faith in the future of his invention.

Italy has always predicted the great advantage of the torpedoplane. During the great war, proper planes were not available, but, notwithstanding this handicap, a squadron of 600 h. p. Caproni planes was formed, to which was assigned the task of defending Venice by means of 1300-pound torpedoes. As it is known, Gabriele D'Annunzio was in command of this squadron.

The British and the Germans also made use of torpedo seaplanes, succeeding even in sinking quite a number of merchantmen.

No doubt can be entertained as to the common employment of this offensive means in future war. The nation operating the most perfect torpedoplane will have easily the supremacy of the seas.

At the present time this kind of aeroplane carries one small torpedo. To torpedo a ship, the aeroplane must first dive to a distance of 1000 meters (3280 feet) from the ship and when about 6 feet from the level of the sea launch the torpedo. It must then execute a sharp turn, rise, and get away at the maximum speed. Obviously this maneuver is very difficult and dangerous and it is almost impossible for the torpedoplane to save itself at such close distance from the light artillery of a ship. It is true that during the World War Commander Luigi Rizzo torpedoed from an Italian motor boat the Austrian battleship *Santo Stefanö* protected by 10 destroyers, but this is a rare example of extraordinary audacity.

From this it can be deduced that the present form of attack of the torpedoplane is extremely hazardous. The ship can hear the hum of the approaching aeroplane and prepare to attack it with all her guns. To make a hit the aeroplane is forced to get perilously near the ship, executing then the appropriate maneuver. The torpedo is then launched. Either the pilot or the observer calculates the direction and the speed of the ship previous to the launching of the torpedo, and, even if they are not injured, the effect of the enemy's artillery on them is such that they lose control of themselves and miscalculate the data necessary to an effective launching of the torpedo.

Notwithstanding these drawbacks, which also apply to torpedo boats, the fact remains that it is now possible to build good torpedoplanes capable of carrying 700-pound torpedoes and having an autonomy of 350 miles.

We can argue that if a fleet possesses 12 or more of these torpedoplanes, its attacking power will be considerably increased. In a naval engagement, after the scout planes have located and reported to the commanding admiral the position and direction of the enemy fleet, the torpedoplanes could be sent to attack the foe immediately.

The present torpedoplane, as already pointed out, is far from perfect, but the result of its use depends entirely on the number of machines used. If one torpedoplane does no damage, a hundred of them attacking all together will. It would be very easy for them to sink in a short time five or six battleships, to the great advantage of the fleet following the aeroplanes. It is of paramount importance to emphasize this point, as only a greater number of aeroplanes than actually needed could compensate the shortcomings due to defective construction.

The torpedoplane of the future will be as faultless as human skill can make it. Presumably the betterments will be directed to

1. The launching of the torpedo at the maximum height and distance from the ship.

2. Having instruments which can readily and without difficulty compute the time and exact direction of the launching.

It is very apparent that the great advantage of torpedoplanes lies in being capable of launching a torpedo from a height of 12,000 feet and at a distance of, say, 5 miles; at such height and distance the plane is rarely visible or heard.

There does not exist at present a gun of this range and, should a weapon be constructed for this purpose, we know how difficult it would be to make a hit in such circumstances. The pilot of the torpedoplane chooses the target and upon arriving at the right point launches the torpedo, turning back immediately. Should the ship have aeroplanes on board, it would take them some time before taking flight to give chase, while the torpedoplane would in the meantime have safely returned to its hangar or its ship.

It is a certainty that in future naval engagements the torpedoplane will be extensively used, and if the battleship be not provided with adequate protection it cannot very well defend itself against such an attack.

A torpedoplane capable of launching a torpedo from 12,000 feet in the air at a distance of five miles has never been built. This however, does not mean that the whole scheme is impracticable, for I can state that, in co-operation with Col. Crocio of the Italian Army, I have studied a torpedo that can be launched at that height and distance.

Needless to say we are sure of the complete success of this engine. Owing to the possibilities of a perfected torpedoplane, much thought has been devoted in Italy to abandoning the construction of great battleships which would be rendered more or less ineffective. Mr. Pio Perrone, the general manager of the Ansaldo Works, the strongest Italian metallurgical firm, has even conducted, through the press, a campaign advocating the discontinuance of the battleships. Mr. Perrone has suggested that, instead of being destined to the building of men-of-war, the appropriation for the navy be employed for the construction of a great fleet of torpedoplanes. That would evidently be less expensive and more efficacious.

It seems to me that the execution of this program is rather an extreme measure, but I am sure that in a few years we will see a new fleet of air destroyers more powerful than the present naval craft. Likewise, I am sure that the battleship of the future will have an effective submarine protection, just as it is now protected against artillery. If the battleship will not efficiently defend itself from the torpedo its end is unavoidable.—*Flying*, April, 1920.

THE GLENN L. MARTIN NEW TYPE NAVY TORPEDOPLANE.—The Glenn L. Martin Company has just completed another new type of torpedoplane for the United States Navy. This plane was given its trial test on May 6, 1920 at McCook Field, Dayton, Ohio. Both army and navy officials witnessed the trial test and consider the performance of the new torpedoplane an unusual success.

The Glenn L. Martin New Type Navy Torpedoplane has a total gross weight of 11,910 pounds, which include a useful load of 4950 pounds. In addition to its crew of three men (pilot, navigator, and gunner) this plane carries a 1650-pound torpedo, 450 pounds of bombs, two Lewis machine guns, a radio set, a complete equipment of instruments and accessories, and a supply of fuel for four hours operation.

It has a flying speed of 107 miles per hour, and will climb from sea level in ten minutes to an altitude of 5100 feet.

Purpose.—The Martin Navy Torpedoplane is the forerunner of a new phase of naval warfare. Its high speed, comparatively small dimensions and unusual maneuverability give it numerous advantages over the present-day torpedo-boat destroyer.

This type of aeroplane is intended for operation either with a fleet or directly from shore stations. Although it is not equipped with floats it has, in addition to its specially designed landing chassis, emergency flotation bags which are inflated by compressed air. Thus it is adapted for landing either on water or on land.

Operation with Fleet.—In operating with a fleet, the plane fully loaded can take off from the deck of a warship or sea sled. Its cruising radius of 480 miles permits of several hundred miles reconnaissance, and by means of its radio equipment accurate communication can be maintained at all times. It can single out the enemy, sweep down and launch its torpedo at close range, thus practically insuring a "hit," and then fly back to its mother ship. By means of its flotation bags which are inflated just before landing at sea, it can alight on the lee side of its mother ship and be hoisted on board by means of attachments in the upper wings.

Coast Defense Element.—As a coast defense element it can operate from the shore or coast defense station and thus take the place of coast defense guns. The average coast defense gun has a range of about 25 miles, whereas the Martin Navy Torpedoplane can fly out to sea a distance of 200 miles, execute its mission and at the same time keep the home station in constant communication regarding its operations. Should an engagement take place so far out to sea as to make the trip to shore impossible, this plane can land at sea by use of its flotation bags, and signal its home station or any nearby ship as to its location.

Economical Advantage.—From an economical consideration 20 Martin Navy Torpedoplanes can be built for the cost of one torpedo boat destroyer, and can be manned by less than one-third of the men required to operate one torpedo boat destroyer. Therefore the loss of one torpedoplane and its crew of three men is comparatively insignificant in realizing that it is just as capable of sinking a battleship as is a torpedo boat destroyer which costs 20 times more and requires approximately two hundred men to operate.

In comparison with coast defense guns which cost on an average of several hundred thousand dollars apiece and have a range of about only 25 miles, the Martin Navy Torpedoplane can cruise out to sea further than any coast defense gun can fire and probably produce more accurate results due to its reduced range of fire.

Design and Construction.—The Martin Navy Torpedoplane is essentially a land type, twin-motored, tractor bi-plane, designed to carry a 2100-pound torpedo (or the equivalent weight in torpedo and bombs), two machine guns complete, radio equipment, a crew of three men (pilot, navigator, and gunner) and sufficient fuel for 480 miles cruising radius.

This new type of torpedoplane has several recent developments, such as folding wings, which when folded reduce the over-all width of the plane to 35 feet 10 inches—thus minimizing the space required for housing. Another new feature is found in the landing gear which is divided in the middle so as to permit the torpedo cradle, capable of carrying a 2100-pound torpedo, to be suspended underneath the fuselage.

The two 12-cylinder Liberty engines are mounted on the lower front wing beams just outside of the first wing strut away from the fuselage. By mounting the motors in this manner the center of gravity is lowered, the flying efficiency is increased, and the motors are made more accessible than they would be if they were suspended from the upper wings or between the struts.

Ordnance Equipment.—Two mounted Lewis machine guns; six Lewis gun magazine drums; 13 sockets for magazine drums; one 2100-pound torpedo, or the equivalent in torpedo and bombs; sighting and releasing mechanism.—*Aerial Age Weekly,* May 24, 1920.

AEROPLANE ENGINE TESTS.—A large number of tests were made with an Hispano-Suiza aeroplane engine in the altitude laboratory of the Bureau of Standards in order to determine the heat distribution of such an engine.

"The results shown in the report in graphical form, together with tables, are the averages of a large number of tests made in order to reach sound conclusions. Speed, altitude and horse-power were the major variables, temperature being kept practically constant. A study of the heat distribution shows that:

"1. The brake thermal efficiency remains constant on the ground at all speeds but decreases with altitude from 24 to 20 per cent. The indicated thermal efficiency remains nearly constant at 26 per cent for all speeds and altitudes. 2. The heat lost in the exhaust is at a maximum at 1900 r. p. m. at all altitudes, and on the ground is almost 50 per cent of the heat supplied, decreasing to 40 per cent at 30,000 feet 3. The heat lost through friction varies from 2 to 3 per cent between 1700 and 2100 r. p. m. on the ground and from 6 to 8 per cent at 30,000 feet altitude. 4. The heat lost in the jacket water is about 17 per cent of that supplied at all speeds on the ground, but at 30,000 feet is 28 per cent at 2100 r. p. m. and 35 per cent at 1300 r. p. m.

"The fuel consumption varies from a minimum of 0.50 pounds per B. H. P.-hour on the ground to a maximum of 0.69 at 30,000 feet. Indicated h. p. appears to vary as the density, and the heat supplied also varies as the density up to about 12,000 feet altitude. The curves between power and speed show that the increase in power with increase of speed is a maximum on the ground, at 30,000 feet there is practically no gain in power with increase in speed above 1700 r. p. m.

"The power lost in friction is a very important factor in the performance of the engine at high altitudes, but its value cannot at present be determined with extreme accuracy. The piston friction was found to be about 80 per cent of the mechanical losses of the engine.

"In tests of the effects of change of density and speed on carburetion it was found that the most economical mixture could be used at 15,000 feet, and greater weight proportions of gasoline to air were necessary at other altitudes, the maximum variation being about 10 per cent." (*Report* 46, *U. S. National Advisory Committee for Aeronautics.* 39 pp., 31 curves.)—*The Technical Review,* May 11, 1920.

THE FUTURE OF AVIATION.—The committee appointed to consider the proposals of the government as to "the encouragement of education and research in the interests of aviation" has issued its report as a White Paper. The recommendations it makes raise the oft-debated question as to the

efficiency of artificial state aids to industry however applied. The members of the committee in common with all men recognize that "at the present moment the industry is passing through a crisis," but will "government support" indeed cause it "to emerge satisfactorily"? We doubt it. "Satisfactory emergence" involves two issues: first, the military issue, or the maintenance of a supremacy in aviation for purely warlike purposes: secondly, the civil issue, or the growth of aviation in its purely commercial aspects. In war the first automatically fuses with the second, but the moment peace is established the interests of the two cease to be identical and common action cannot forward them. The committee would seem to ignore that fact.

We keep the civil issue under review. The crisis through which the industry is passing may be stated briefly to be due to the huge cost of the practice of aviation. In peace conditions aviation lies beyond the reach of all but a very few, whose interest coincides with their possession of the means necessary to follow it. In war time such was not the case: all the productions of the industry found an excellent customer in the state. The return of peace reduced the market at a stroke to dimensions not greatly larger than in pre-war days. Speaking broadly, civil aviation is not a "business proposition," and as long as it remains so, so long will the best brains gravitate towards fields of activity in which the prospect of rewards is less limited. We must not be surprised if the motor industry, for instance, attracts many that in other circumstances might have devoted their work to the aviation industry. The cry for economy will effectually limit official baits. Moreover, it is a proven fallacy that such baits can exert more than a fugitive influence upon the operation of the laws of commercial gravitation. State control has surely shown us that. Not that the committee advises a step reaching so far as the wholesale subsidizing of the industry. On the contrary, it contemplates merely the formation of a Department of Aeronautics at an estimated yearly expenditure of £10,000 and the placing of the results of any research achieved in the hands of the civil industry. This measure may serve the interests of the military issue. On that point we are not at the moment concerned to argue, except in so far as to indicate that fairly rigid limits will thus be imposed on the activities undertaken. But the assumption that the civil issue will, under perfectly normal industrial conditions, benefit by military researches is almost certainly ill-founded. Experience shows that the flow of ideas always takes place in the other direction—from civil to military. It is the ancient case of mercantile marine and naval practice all over again. Who ever heard of the official world—the world responsible for the military issue—adopting a capital improvement, whether in the use of steam, the turbine, oil fuel, or internal combustion marine engines, to take random examples, until after it had first stood its test in the commerical world?

We are convinced that, deprived of the artificial stimulus of war, aviation must grow, if it is to grow at all, under the old rule of supply and demand. But we must fairly face the fact of the return to peace conditions. War has left as legacies opposing forces. The economic state tends to limit demand through adverse influence on the cost of flying. The immeasurable gain in practical knowledge tends to extend demand through the attainment of greater reliability. The resultant favors development. There is now, and always will be, a nucleus of patrons to whom the time saved by the employment of aviation in moving persons, and to some extent goods, makes it a necessity; whatever the cost. As commerce increases so will that nucleus increase, but no artificial stimulus can save it if, for inherent reasons, it cannot be accepted on a sound commercial basis.—*The Engineer*, Feb. 27, 1920.

ENGINEERING

GEARED MARINE TURBINES.—The discussion on Engineer-Commander Tostevin's paper at the recent meetings of the Institution of Naval Architects was more remarkable for its reserve than for the information, valuable as it was, that it contained. Many of those present must have known full well that reduction gearing, particularly the double reduction form, is giving some anxiety to shipowners, and that there have been serious failures. But the mishaps were barely hinted at in the debate, and there was little or no attempt to discuss technically the problems involved. It is, we suggest, desirable in the interest of British engineering that the matter should not be kept in the hands of marine engine builders, gear cutters and shipowners. The failures, we believe, are not of a kind of which anyone need be ashamed. They are the outcome of a lack of knowledge and experience, and as such are to be expected in the early stages of a new development. There is no reason to suppose that anyone's reputation would suffer by the open discussion of them, and a great deal might be gained by directing the whole weight of engineering knowledge upon the problems they raise. Here, surely, is a case where the two learned bodies directly interested—the institutions of Mechanical Engineers and of Naval Architects—would serve their members well, and serve the profession well, by arranging a joint meeting at which the problem in all its details would be thrown open to discussion.

We are, unfortunately, constrained to write with some reserve, because we feel that we must not at present far exceed the limits prescribed by Engineer-Commander Tostevin's paper and the discussion on it, but one or two interesting points may be touched upon. The failures may roughly be divided into three categories—wear of the teeth, excessive noisiness, breaking of the teeth. Engineer-Commander Tostevin dealt only with Admiralty practice, and in the navy there is no experience of double reduction-gear. The single gear appears to give little trouble, and the problem which has to be solved is why double gear should not be equally as immune. But even single gear is not free from one of the troubles at least, namely, pitting near the pitch line. The pitting is due to flaking off of the metal, and it is rather remarkable that it should occur in the very region where rolling action is assumed to be most nearly complete. We are, in this connection, naturally reminded of the corrugating of rails, and are led to wonder if a similar phenomenon occurs. Pitting appears to continue for a time and then to cease, and it is reported not to be a serious defect, but on that point we suggest that opinion ought to be reserved. We could, were it desirable, quote one case in which flaking was so pronounced that the oil filters had to be cleared frequently of the minute particles of steel. In the earlier sets of gearing a load per lineal inch of tooth of 600 pounds to 800 pounds was not exceeded, but in the *Hood* 1000 pounds is allowed; and in a general way it may be taken that that figure has hitherto been regarded as safe with the latest materials and the most accurate methods of tooth development. As many gears are running successfully with that designed pressure, the question arises why others fail under it. Assuming, as we may fairly do, that the material is good, and that the teeth are cut to a proper form and are accurately pitched, we are forced to the conclusion that one of two things occurs. Either that much higher pressures are in fact attained, or that lubrication fails; or, to go a step further, it is no doubt safe to say that if an excessive pressure is reached, then lubrication will fail by disruption of the oil film and contribute to a breakdown. It is, we think, to existence of excessive pressures that first attention should be directed. Lubrication of wide gear teeth presents many interesting problems, but it may be assumed that if the present means are not perfect, they are at least adequate, and that were no other cause of failure present the lubrication system would give satisfactory results. After a careful study of all the information we have been able to secure, we are disposed to attribute the whole trouble to exces-

sive pressure. We do not say that 1000 pounds per lineal inch is too great. If it were never exceeded the gear at sea would work with as little trouble as similar gear ashore. What we are convinced takes place is that owing partly to the working of the ship and partly to temperature changes, small errors in alignment occur and are followed by great augmentations of pressure. It may be said that owing to the solid construction of the framework of turbine and gearing, such changes are impossible. We cannot accept that view. Even the strongest framework of metal is readily distorted through a small amount, as everyone owning a delicate measuring machine knows well, and there can be little doubt that twisting and warping of the bed and frame on which the turbine and gear box are carried occurs. These movements are no doubt slight, but we are confident that were an appliance rigged up for the purpose of measuring them on a ship at sea, it would be found that changes of a material kind do take place and that pressures much higher than are provided for result. It is worth observing that wherever trouble has been so pronounced that the speed of the ship had to be reduced, the trouble has at once ceased altogether. It is, of course, possible to adduce one of two things from that fact, either that the rubbing speed is too great or that the pressure is too great. But since it is the low-speed gear with high pressure that gives the trouble, whereas the first or high-speed gear is free from it, we think the second alternative must be accepted.

If our conclusion be correct, then there are three courses of action that may be taken. First, we may improve the metal; secondly, we may reduce the pressure; lastly, we may fix the alignment. It is doubtful if much better metal can be used than that now employed, and if the pressure per lineal inch is reduced the length of the gearing must be considerably increased. Finally, if the alignment can be kept accurate under all conditions, then not only would the present metal be perfectly suitable for the present pressure, but it might be found that even higher pressures could be sustained without difficulty. We suggest, then, in conclusion, that steps should be taken to design instruments that would check the alignment at sea and with the gear running. The apparatus would be delicate and costly, but it would well repay the outlay, even if in the unlikely event it proved that there was no change of alignment.—*The Engineer*, May 7, 1920.

A BOILER TUBE FAILURE.—In a recent issue of the *Journal* of the South African Institution of Engineers, Mr. T. G. Otley described a case of boiler tube failure. The tube in question was in a bottom row of a water-tube boiler and was 3¼ inches outside diameter and No. 7 gauge. The tube opened out for a length of about 10 inches, and as a result of the burst a large proportion of the fire was blown out of the furnace and the boiler house was filled with smoke and steam.

The failure, said Mr. Otley, is of more than usual interest, in so far as it very clearly ilustrates a theory which he has held for some considerable time. When the burst occurred the furnace was fired with a high-quality Witbank district pea coal with high furnace temperature—approximating he judged, to about 1350° C., and no doubt the boiler was doing something more than its full load output. The calculated output was about 46,000 pounds per hour. It is, of course, well known that in all boilers heating surface nearest to the furnace does a disproportionately large fraction of the work. The bottom row tubes in water-tube boilers are worked very hard, but under normal working conditions they come to no harm because the water is in contact with the inside surface of the tube and the metal cannot be overheated. Assume that the furnace temperature is, say, 1300° C., the temperature gradient across to the wall of the tube is a very sharp one—*i. e.*, down to, say, 200° C. the temperature on the water side—but further assume, as is reasonable under certain conditions of working, that steam bubbles attach themselves to the wall of

the tube, then the temperature gradient is altered, and while remaining the same on the furnace side, the temperature may easily rise to 700° C. or 800° C. on the steam side, under which condition dissociation of the steam will occur and the metal on the steam side will become oxidized, forming thin layers of oxide. With the bursting of the steam bubble, water at approximately 200° C. temperature comes in contact with the tube, which contracts and the oxide cracks away. One can imagine this process being repeated until the sound metal is reduced very much in thickness until finally it is unable to resist the pressure combined with the temperature, and it then opens out and bursts. Careful measurements of the burst tube showed that it had stretched very little, but the thickness of the tube nearest the fire, where it burst, came down almost to a knife edge. On the other piece of tube adjoining the burst an incipient blister was forming, and iron oxide on the steam side was clearly in evidence. It was also clear that some of it must have been cracked off and swept away by the rush of steam and water. The trouble cannot be accounted for by the quality of the material, which was excellent in every respect. The moral to be drawn is that when boilers are to be worked very hard it is of the first importance that the feed water should be of excellent quality, and that the lower tubes should be cleaned at fairly frequent intervals to prevent anything except the slightest scale adhering to them. As a matter of general practice Mr. Otley said that he put the turbine cleaner through the three bottom rows of the tubes every 1000 to 1500 hours.—*The Engineer*, May 14, 1920.

THIN STEEL BELTS FOR MAGNETIZED PULLEYS.—The use of thin steel or iron belts on magnetized pulleys to transmit power has been patented in France. The magnetization of the pulleys is effected by windings lying in helicoidal slots on the surface of the pulleys. The thickness of the belt should not exceed about 0.06 times the diameter of the smallest pulley. With a steel belt of 1/6 inch thickness making contact over an arc of 145 degrees on a pulley of 10 inches diameter running at 4000 revolutions per minute, it is possible to transmit more than 200 horsepower per inch width of belt. With a pulley of 50 inches diameter running at 800 revolutions per minute, a belt of 1 inch width will transmit 1000 horsepower. Steel belts may be run at speeds of 18,000 feet per minute so that this method of transmission is suitable for speed reduction with turbines.—*Scientific American*, May 22, 1920.

MYSTERY ENGINE.—One of the ships delivered to Britain by Germany under the terms of the Armistice is equipped with an engine of new type, the working of which has to be discovered by our engineers without any drawings to help them, and with no assistance or instructions from the builders. The engine is described generally as "a double-acting marine Diesel engine," is of very high-class workmanship, but contains numerous evidences that it is somewhat experimental. (*The Engineer*, Apr. 2, 1920. Two and one-quarter columns.)—*The Technical Review*.

ORDNANCE

GERMAN BORE SIGHTING AT SEA WITHOUT USE OF DISTANT OBJECT.—There were obtained from the ex-German ship *Nymphia* some very remarkable bore sighting arrangements used in the German Navy. As far as is known, all other navies bore sight by putting a bore sight in the axis of the bore and making such adjustments to sight as may be necessary, with scale set at 0° to bring both sight and bore sight on the same distant object. In good weather the horizon does pretty well for the horizontal cross wire, but in bad weather it cannot always be seen clearly, and at sea the ship may be rolling badly. At sea, there is the difficulty of there being nothing to check up the vertical wire. The need had been felt for

a long time for some arrangement that would allow a ship to do its bore sighting readily at sea, and without the complications involved in the use of a distant object. This device, by means of prisms, allows the gun pointer to look into the breech of his own gun and to look down the bore with his own sight.

Various other systems to bore sight at sea without using a distant object have been attempted. One is to have bench marks on the ship as far distant as possible from the guns so that, when the gun is properly bore sighted, the bore sight is on one of these marks and the sight is on the other. Such bench marks can be put well forward on the forecastle, or well aft on the quarter deck. The usual argument against their use is that distortions of the ship ruin the accuracy of the method, and that the distance from the gun is too short for good accuracy anyway. When one carefully studies the matter and investigates the magnitude of all the quantities involved, the system looks much better than most officers consider it, and it is thought by many that it is worth while to have such bench marks and to use them.

Bore sighting in port on battens erected on the forecastle or quarter deck is, of course, the most familiar method of checking up sights and bore sights without the use of a distant object. But this cannot be done rapidly, nor at sea in active service under war conditions, and cannot be classified as a method for rapid bore sighting at sea in service without the use of a distant object.

Another scheme, tried by the Bureau of Ordnance and not generally known, consisted of putting on a small attachment a few inches long, screwed into a hole near the muzzle of the gun. This carried a pair of cross marks which were located in front of the sight when it was set at 0°. This method never came into general use, and only a few guns are fitted that way.

To sum up, it may be said that the usual methods for bore sighting, without the use of a distant object, involve bench marks of some sort, either on the gun or on some other part of the ship.

Method Used by Germans in Bore Sighting at Sea Without Use of a Distant Object.—There is a small attachment containing prisms in the form of two optical squares. A ray of light entering one of the opening is reflected across and comes out of the other opening, turned back parallel to its original direction and displaced to the side about 95 mm. In this way, by putting this small fitting in front of the sight, a gun pointer can adjust it so that his head does not interfere with the line of sight which comes to the rear. In the breech of the gun there is placed a carefully manufactured self-centering plug. This plug carries a jointed periscope. The two legs of the periscope may be set at any angle to each other, and this angle is shown on a scale at the joint. The idea is to adjust the opening in the second leg of the periscope so that the line of sight, in coming back to the rear, enters the object glass. The line of sight will then be reflected up one leg of the periscope, across through the joint, down through the other leg of the periscope and out into the bore, parallel to the original axis of the sight telephone.

It will be seen that altering the angle in the jointed periscope, so as to separate the legs apart or close them in, enables the opening in the second leg of the periscope to be put at any desired distance from the center of the bore. Furthermore, the whole arrangement can be put in the breech at any desired angle. Thus the opening for the line of sight to center has sufficient adjustments to put it anywhere as it is desired to have it. There is a scale on the circumference of the breech fitting which shows how the breech fitting is put in the breech. There is one adjustment for the sight on the left of the gun and another one for the sight on the right of the gun. For instance, for use with the left sight, according to certain memoranda, the scale on the breech would be set at 216¾°, and the scale at the joint would be set about 307¼°. For use with the right

side, the reading at the breech would be 143¼°, while the scale at the joint of the telescopes would read 52¾°.

These scales were not scales of precision. One's first impression is that the accuracy of the whole arrangement depends upon the establishment, with mathematical accuracy, of certain distances which the line of sight and the parts of the periscope must be placed from the axis of the gun. Really this is not the case. If it were the cases, the whole instrument would be very impracticable. It needs only a glance at the scales to see that they are rough and only for approximately locating the different parts. The apparatus depends for its success upon the parallelism with which the rays enter and come out of the optical parts, and this parallelism is not affected by the fact that the periscopes reflecting prisms, etc., may be slightly displaced from their ideal positions, so that the line of sight may be a little off center from the middle of the different openings. So long as the line of sight gets from the sight telescope into the bore of the gun, it gets there parallel to its original direction. It may enter the opening of the periscope almost at the edge of the forward opening. The small reflecting prisms in front of the telescope sight may not be perfectly at right angles across the axis of the gun, but neither of these facts would affect the parallelism of the line of sight in the bore, and in the sight telescope itself. Things would be seen slightly off the center of the field.

Lenses in the Bore.—Another box of bore sights was discovered which, it appears, can be used for distant objects in the ordinary way and may, or may not, be used in conjunction with this apparatus. There is an elaborate muzzle fitting with a lens in it and crosslines on it. There is a fitting which goes in like a cartridge case and carries other lenses at the afterend of the bore. This occupies the position where the cartridge case would go. An eyepiece extends to the rear. By this method, instead of having a small telescope a few inches long, we have virtually converted the whole gun into a telescope almost as long as those used for astronomical purposes (naturally the lenses are very flat). For ordinary bore sighting on a distant object this method of having lenses at both ends of the gun, and converting the whole gun into an enormous telescope, offers certain obvious advantages. A similar fitting for an 88-mm. gun was also found in the same box. The other fittings and the periscopes were for a gun of 150 mm. caliber.

It is believed that, in using the apparatus, the muzzle fitting with the cross wires is viewed from the sight and that the image of the other crosslines in the telescope is brought to coincidence with it.

All details of the apparatus have not, at this time, been sufficiently studied to enable one to make a definite and positive statement as to exactly how the apparatus is worked. Optical experts are engaged in making a full report. This, however, will take some time. In the meantime there are certain things which we can be absolutely sure of, and these are believed to be sufficiently interesting to make a report on at this time:

(1) For bore sighting at a distant object, the Germans used lenses at both ends of the gun.

(2) For bore sighting at sea without the use of a distant object they used an arrangement for reflecting the line of sight of the telescope so that it looked into the breech and down the bore.

(3) The number of this periscope fitting was 168. The date on it was 1914. It was issued to a not particularly modern ship. This seems to establish the fact that the Germans have used this method extensively and for a very long time.

GERMAN NAVAL GUN-SIGHTING TELESCOPES.—The instruments described are a periscopic sight, a right-angle sight, and a variable sight all made by Carl Zeiss, Jena. Details of the mechanical and optical properties are given. The refractive indices and dispersions of all the lens components

and the prisms were measured by means of a new method of immersion refractometry. The types of glass employed could thus be determined.

"Among the more interesting points in connection with the sights are the methods adopted for protection against scattered light and for ensuring that the instruments should be water-tight. The sights are provided with detachable spray excluders.

In the periscopic and right-angle sights the cross-lines on the graticules are illuminated for night work by means of two small glass tubes filled with a luminous compound. These can be brought opposite the edge of the graticule by turning a small lever. Each instrument is provided with an eye-piece cap of the asymmetrical type (*i. e.*, it has a sideflap), which is very much superior to the usual symmetrical type. Three color filters are employed in each sight, namely, green, orange, and neutral. Spectrophotometric measurements of the percentage transmission of these filters were made throughout the visible spectrum.

"The paper contains diagrams illustrating the mechanical details and the optical systems of these instruments." (J. S. Anderson, M. A., B. Sc., Ph. D., and A. Barbara Dale. *Transactions of the Optical Society*, vol. 20. No. 9, 1919. Twenty-three pp., 10 figs.)—*The Technical Review*, Apr. 27, 1920.

NAVIGATION AND RADIO

THE NEW BOX SEXTANT.—The instrument is designed for hand use where it is not convenient to employ a theodolite with stand. It is adapted for the measurement of angles on the sea, in the air, or on land, both by night and day.

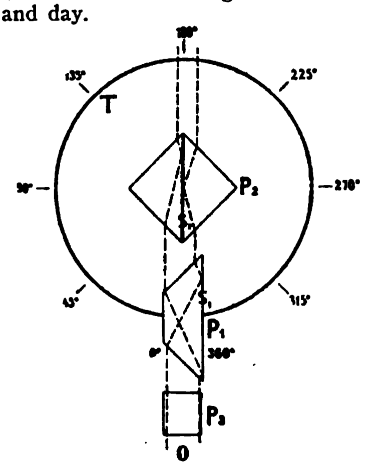

FIG. 1.

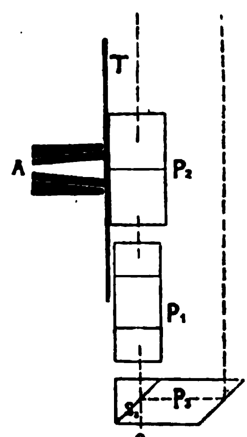

FIG. 2.

"The instrument consists essentially of two prisms, P_1, P_2, (Figs. 1 and 2), placed one behind the other. Fig. 1 shows the arrangement of the prisms as seen from above, and Fig. 2 represents a side view. P_1 is a simple right-angle prism with the mirror surface S_1, while P_2 is a double prism built up of two right-angle prisms, the two surfaces in contact at S_2 being both silvered. The prism P_1 is fixed relative to the apparatus. The prism P_2, together with the divided circle T and the axis A, can be rotated by means of both rough and fine adjustments. A third prism, P_3, is built up of two parts, the surface separation S_3 being half silvered. The object of this prism is to enable the observer to get a free view over the prisms P_1 and P_2, as well as a view through them.

"The chief advantage of using a prism instead of an ordinary plane mirror is that the effective aperture remains more uniform during a rotation as can be seen from the following table:

	Effective apertures at different angles		
	Plane mirror	Single prism mirror	Double prism mirror
0°	1	5	.5
90° and 270°			
180°	0	.25	.5

"In this table 0° represents the direction in which the light is reflected backwards. The values of the effective apertures of the prism systems are calculated on the assumption that the angles next the reflecting surfaces are each 45° and the refractive index of the glass is 1.57. A further advantage of using a double prism instead of a single one is that for the complete circumference only one half revolution of the prism is required.

"It is necessary that the reflecting surfaces of the double prism should fit exactly together and should be parallel to each other and further, the prisms should be free from pyramidal errors. The angles next the reflecting surfaces need not be 45°, but in each prism they must be equal.

"In order to be able to make measurements of angular distances greater than 135°, a pentagonal prism can be inserted in the path of the ray which enters the top of the prism P_2, so that the free view is now to the side. The divided circle is viewed by means of a small microscope. The reading is accurate to about 1 minute.

"The instrument is provided with a handle which can be screwed into the bottom or side of the box, according as the angle measurements are required in a horizontal or vertical plane. For observation on the sun a neutral tinted glass is provided for insertion between the prisms P_1 and P_2.

"The method of obtaining an artificial horizon is as follows: A collimator, attached to a pendulum system, is placed in front of the upper portion of the prism P_2. It can be adjusted until its optical axis is horizontal when the pendulum is at rest. In the field of view of the collimator there is a bright line on a dark background. By rotating the double prism the image of a given object can be brought into position where the displacements of the line on either side are equal, when the pendulum is swinging.

"A small telescope (4x) may be used with the instrument.

The author describes how the apparatus is used in making a number of distinct types of measurements and he suggests that it may be employed for determining the distances or sizes of distant objects." (C. Pulfrich, *Zeitschrift fur Instrumentenkunde*, 39 (1919), 201; abstract in *Central-Zeitung fur Optik und Mechanik*, Jan. 1, 1920.)—*The Technical Reveiw*, May 11, 1920.

FUNCTION OF THE U. S. NAVAL OBSERVATORY.—To sum up, the Naval Observatory performs four principal functions, which are not only absolutely necessary to the navy and shipping interests of this country but to the country at large. These functions have been developed by the navy as the needs for them have arisen, and the plant has been provided by Congress upon the representations of and work done by the navy.

These functions are:

(a) The furnishing and transmission of daily time signals both by radio and telegraph.

(b) The computing and preparing for publication of the American Ephemeris and Nautical Almanac and the Nautical Almanac.

(c) The continuous maintenance of observations for absolute positions of the fundamental stars, and the independent determination by observations of the sun, of the position of the ecliptic, and of the equator among

the stars, and of the positions of the stars, moon, and planets with reference to the equator and equinoxes in order to furnish data to assist in preparing the American Ephemeris and Nautical Almanac and improving the tables of the planets, moon, and stars. At the same time this department furnishes the observations for determining the time.

(d) The development, supply, upkeep and inspection of all navigational instruments for the navy, which incidentally the observatory has practically done for the Shipping Board, and has established standards for the growing merchant marine of the country.

The Naval Observatory started the development of the Hydrographic Office; made the first systematic meteorological and magnetic observations at the Capital; and has lately fostered the development, among many other instruments, of those necessary for the navigation of submarines and air craft.—*Rear Admiral Hoogewerff, in the Franklin Institute,* April, 1920.

HARDENING AND SOFTENING OF VACUUM TUBES.—A recent issue of the *Radio Review* contains an interesting discussion of what happens to the gas in the so-called vacuum tube when it disappears. Dr. Eccles, the well-known radio authority, holds that the gas goes into the filament. It is pointed out that to do this the gas which may in certain circumstances be absorbed in a valve would occupy when fully condensed a volume equal to one-fifteenth of the filament itself and it is improbable that so much gas could be taken up by a solid heated to incandescence. On the other hand, if the gas were absorbed by the walls of the glass tube, the amount of gas so removed would form a layer only about one molecule thick if evenly spread over the glass. The existence and stability of such layers have long been recognized.—*The Scientific American,* May 22, 1920.

MISCELLANEOUS

ANTI-SUBMARINE NET DEFENCE.—During the war experiments were carried out at Teddington on two types of nets, one intended merely to indicate the presence of the submarine, the other to prevent its passage.

"Indicator nets are of light construction and intended to be ripped from their frame and carried off by the submarine; to them are attached buoys, which are towed on the surface of the water and so betray the submarine's motions. The main problem is concerned with the type of buoy; most of those tried at sea were either unstable or else of such high resistance as to break their tow ropes in any sea. Flat-bottomed floats intended to plane did not make enough splash in fine weather, and in rough their slamming broke the tow ropes. A satisfactory form was developed at the tank, having a spoon bow and a V-shaped transom; all the buoyancy was forward, the weight aft, and the stern was left open.

"Defence nets may be of three types, and arrest the submarine (1) by retarding its motion without showing it; (2) by deliberately converting its translatory motion into a rotary one—upwards, downwards, or sideways; (3) by loading it so as to sink it. The third type was not experimented with. Model nets were made proportioned as to strength and size of mesh to suit a model submarine similar to an E-class vessel, which was run at suitable speeds and into the net under its own power. The damage to the net was observed, as also the motion impressed on the submarine; in many cases cinematograph records were taken.

"The nets were made of large mesh, and it was found that horizontal and vertical wires behaved slightly better than diagonal ones. They were supported by floats which were attached to a strong wire or jackstay; the horizontal wires were made rather stronger than the vertical, as they are usually met by the stem of the submarine and belly out at a sharp angle, either one or two wires having to stand all the load, while the vertical wires transfer the load to the jackstay. When a submarine hit the net a bulge

formed, and the vertical wires receiving support from the jackstay caused the bow to turn upwards as soon as the bulge was sufficiently large. The bow reached an angle of 30° to 50°, and the boat was brought gradually to rest and then forced backwards with the trim increasing. As the bow lifted the net settled more on top of it, and there was less chance of its being pierced.

"It was found that if the jackstay was moored too rigidly the net was pierced before the bulge could properly develop; the best results were obtained by allowing the jackstay to "render" when the strain reached a pre-determined value, the strain being maintained as it rendered. The experiments showed that the stopping speed of the net varied as the breaking load in the vertical wires, and for best results the jackstay and strain had to be about one-third of this, increasing to a maximum of not more than 80 per cent when it had rendered about 40 per cent of the length of net supported." (G. S. Baker, Paper read before the Institution of Naval Architects, Mar. 24, 1920.)—*The Technical Review,* Apr. 27, 1920.

SOME PRINCIPLES OF NAVAL DESIGN APPLIED TO COAST DEFENSE.—The object of this article is to set forth some new ideas as to the tactical arrangement and control of the armament of a coast defense fort derived from the study of the principles of battleship design and armament. The object of a coast fort being to defend a city or harbor against a hostile fleet bent on destruction, or the landing of troops, it follows that there is a great deal of similarity between a fort and a unit of a battle fleet, viz., the dreadnought, as far as armament goes. The natural opponent of a battleship in an artillery battle is another dreadnought, and hence one infers that a fort, designed as far as the armament is concerned on the principles of a battleship or superdreadnought would be the most effective enemy of the hostile fleet. The main difference between a fort and a battleship, tactically, is that the fort is stationary, provides a steady gun platform, has better range finding facilities, and its vulnerability is less. But these differences, which are also advantages, do not alter the usefulness of the principles advocated here. Therefore the principles of armament applied in battleship design suggest their application in a modified form to forts of the coast artillery.

The features referred to are: (a) The "all-big-gun" principle; (b) the powerful secondary battery; (c) central control and fire direction; (d) and a design which subordinates all the auxiliaries and component parts to the "main battery" as the navy calls it, or the major armament, as it is called in the coast artillery corps.

In 1906, as a result of the experience gained in the naval battles of the Russo-Japanese War, the British Navy laid down the first "all-big-gun" ship, the *Dreadnought.* This name has since become the class name of all ships of her type. the later and larger ones being sometimes called "superdreadnoughts." The British completed their *Dreadnought* before we completed the *Michigan,* our first dreadnought. The lesson that had been learned from the naval battles of the Russo-Japanese War was that in a battle between battleships, the intermediate armament was practically useless, as the tendency was to fight the artillery duel at maximum ranges, or the range of the largest guns on board. Hence the ship carrying the larger guns, and more of them, has the advantage. Of course the question of speed is important, as the ship of superior speed can choose whether to fight, and where to fight. The great naval battles of the Great War have proven the correctness of this principle, as all the great battles were fought at maximum ranges, and the fleet having the greater number of large guns of approximately the same range was superior.

With a great many of our forts, especially those on the eastern coast, a hostile fleet of superdreadnoughts could lie out of range of the major armament, or if not, could at least concentrate on the forts more large-caliber fire than the forts could return. It is problematical whether the

admitted advantages of a fort over a battleship would make up for the far greater number of heavy guns on the ships. Actual battle, such as the attacks on the Dardanelles and on the Belgian coast has proved that a fort has a decided advantage over an attacking fleet, other things being equal, due to the steady gun-platform, better range finding facilities, and the less vulnerability of the fort.

It is therefore suggested that the "all-big-gun" principle be applied in a measure to our coast defense forts. By this is meant that there should be at a fort, or rather in a coast defense, only two calibers of guns as on a dreadnought, that is, 14-inch or 16-inch guns, and the secondary batteries. The 8-inch, 10-inch, and even 12-inch gun should not be mounted, as no more capital ships of the major powers are being built with these calibers in their main battery. (The main battery, as applied to a battleship, means all the guns of the maximum caliber.) The 14-inch guns may be mounted on either a barbette carriage or railroad mount as both have been practically demonstrated, and the type of mount has nothing to do with the principles advocated here. And, regardless of the type of carriage found most suitable for the 16-inch gun, the above principles will hold.

The secondary batteries of modern dreadnoughts are heavy; the tendency in the newer ships being away from the 2- and 3-inch to the 5-, and even 6-inch. The navy 5-inch rapid-fire was the gun most used on the United States transports during the war for anti-submarine work. As nearly all modern auxiliaries, mine sweepers, destroyers, destroyer leaders, and light cruisers are armed with a heavier gun than a 3-inch, and as these are the boats that sweep mines, destroy harbor nets, carry landing parties, and partake in raids on harbors, it follows that our mine batteries, whose duty it is to oppose these vessels and their operations should be of equal caliber and range. A suitable 5- or 6-inch rapid-fire gun combines good range and destructive power with a high rate of fire. Their service, I have actually observed, is no more difficult or intricate than our ordinary 3-inch. With mine batteries of 5- or 6-inch rapid-fire guns, the forts will also have the superiority in this class due to the acknowledged advantage that accrues to the land position, as explained above. The searchlights and self-contained base range finders are a valuable addition to these batteries, while they are practically useless at the extreme ranges possible with the 14- or 16-inch guns.

The mortar has no parallel on board ship, since a ship does not constitute a suitable gun-platform for them, and the accurate range-finding necessary for mortars cannot be accomplished on board ship. But mortars are only made in the larger calibers for coast artillery, so they are in harmony with the "all-big-gun" principle. The most important consideration then, becomes that the mortars have approximately the same effective range as the major caliber guns.

Another new feature embodied in the latest battleship designs is the ability of the main armament to be fired at any elevation up to about 30 degrees. The *New Mexico, Tennessee* and *California* of our own navy are so designed. If this can be accomplished on board ship it can more readily be done with coast guns, and the increase in range consequent upon this increased elevation of naval guns should be met by a similar change in the major caliber guns of the coast artillery.

The central control and fire direction which is embodied in the design of modern battleships may also be applied advantageously to the organization of a fort's artillery in battle, in a modified form. In a fort this could take the form of a central command station like the present fort commander's station, a central range section, and a central spotting section. The *range section* would have under its control all the available means for finding ranges, such as visual (with azimuth instruments and base-end stations), directional radio, observation balloons, sound ranging, etc. This central *range section* would employ that system which was most suitable or which was available, sending the resulting ranges and other data to the central

plotting room. In the central plotting room the data would be corrected, computed, and "relocated," and correct data sent to each individual battery. Likewise the central *spotting section* would "spot" or observe for such batteries as designated by the fort commander, using the best means available (such as observing stations, airplanes, or balloons, etc.) and send the results to the central plotting room where the results would be applied to the data for the respective batteries concerned. Both the *range section* and the *spotting section* should be so arranged as to operate also on all land targets in range of the fort.

The modern means of range finding, observation and correction of fire, and even of range computation, are so complex and expensive as to prohibit their individual use by each battery. By centralizing these services, as outlined above, for a whole fort, all batteries may have the advantages of such modern means. Actual experience has proved that, even under the most ideal weather conditions the present system of visual range finding from azimuth stations on a horizontal base is inadequate; and that a great part of the time the system is absolutely useless for any but the shortest ranges due to fog, mist, low visibility due to other causes, and darkness. Much of this suggestion is not original with the writer but is included as part of the principles embodied in naval design.

Therefore, other means, such as: horizontal base with observation balloons at each end to determine azimuth of target; directional radio stations (as used with the Radio Compass); and sound ranging, must be resorted to, and these are the different means attached to the range section of the central station in the diagram of proposed organization.

The central plotting and computing room, fire direction station, and telephone exchange should be in a bomb-proof above which would be the observing station and post of the fort commander, the chief spotter, and searchlight officer. A secondary station for the searchlight service and the spotting service would have to be provided at the other end of the "fort base line," with an auxiliary fort commander's station in duplicate in case of destruction of the main one. The apparatus mentioned above for the bomb-proof would not require duplication.

This centralization of the plotting and fire direction work in one station would greatly simplify the fire control and communication system of the fort, as well as effecting a great saving due to the reduction in the number of necessary stations with their appropriate apparatus.

Centralization would also make possible the firing of "fort salvos" of the major caliber guns, giving the concentrated destructive fire possible only with this type of fire.

In order to combine the principles outlined above in the design of a fort or coast defense, it would be necessary to design the fort as a unit with that object in view. The guiding thought must be the size and number of the major armament. After this has been decided upon, all other features of the design must be coordinated and also subordinated to the major caliber batteries. By this is meant the size, number, and location of power-plants, shops, storehouses, searchlights, quarters and barracks, telephone system, railroad facilities, and fire control apparatus and stations. The main battery is the *raison d'etre* of the fort or coast defense, and should govern all other matters, since all other units of a fort are subservient to the major armament, in this system.

It is not the intention of this article actually to describe the design of such a unit "all-big-gun" fort, but merely to call attention to some of the main principles of naval armament, and to suggest their application to coast defense forts from the analogy of the fort's opponent, the dreadnought. It is presented in the form of a theory for further discussion by the members of the coast artillery corps.

In conclusion the following outline of the advantages of this system is given:

(a) A great saving would be effected in the amount of fire control equipment required for a fort due to doing away with plotting rooms and observing stations for each battery. Here would be a saving in initial cost, and in upkeep and repair.

(b) A saving due to a greater quantity of one type of gun being manufactured, permitting quantity production of the guns, carriages, and all accessories and spare parts.

(c) A saving in repair and maintenance of the batteries, as less spare parts would have to be carried in stock by the ordnance department.

(d) It would be easier to develop efficient battery commanders and artillery officers for the staff (range officer, searchlight officer, spotter, etc.) because there would be fewer types of guns, and the system at all posts would be standard.

(e) It would be easier to train efficient personnel because of the reduction of number of types of guns, carriages, fire control stations, ammunition, etc. The navy aims to do this by having ships built at same period of same type, thus making transfers of officers and men from one to the other no handicap to efficiency; the same would apply to different forts.

(f) A less number of highly trained enlisted men would be required because of the reduction in number of B. C. stations, plotting rooms, observing stations, isolated power-plants and fire commander's stations.

(g) A more effective fire could be wielded by the commander of a fort of this type. He could engage the hostile fleet at the same time or before it could open fire, and, having the advantage (which was proved in the disastrous attacks of naval forces on land forts in this war) that goes with a steady gun platform and superior range finding equipment and lower vulnerability, can clinch the victory.

(h) The use of all kinds of automatic machinery is easier in such centralized and standardized fort.

(i) By increasing the effective weight of the fire of the fort and maintaining only one fire direction and range finding station it will be possible for each fort to have all the expensive modern scientific auxiliaries such as balloons, airplanes, radio direction finding sets, etc. It would be out of the question to provide this equipment individually for each battery when it can be used to serve the whole fort through the central control station as does similar equipment on a dreadnought.

Many of the ideas here outlined are not new and have already been advocated, hence the purpose of this article is mainly to consolidate them and show the analogy to certain principles of naval design.—*Journal U.S. Artillery,* May, 1920.

WHY THE GERMAN NAVY FAILED.—Captain Persius, the sanest and most noted of German naval critics, has written a book on "The Sea War." As the naval expert of the *Berliner Tageblatt* he had chafed bitterly at the iron restrictions placed upon him by the German censorship. When that censorship was removed, he wrote his book to tell what he thought of the German naval policy before and during the war. His revelations constitute one of the most formidable indictments of the ex-Kaiser and his naval chief, von Tirpitz, which have ever appeared in print. Like Maximilian Harden, Captain Persius criticises wholly from the German viewpoint, a method which makes his attacks all the more deadly.

At the outset Captain Persius gives interesting details of the personalities of the ex-Kaiser, who was the Supreme Chief of the German Navy, and of Prince Henry of Prussia, who occupied the position of senior admiral. Of the building up of the German Navy he says:

"With a few cruisers and with the friendly assent of Great Britain Bismarck gained nearly all our colonies for us. No threat was seen in our naval armaments, which fully sufficed for Germany's interest. But at the end of the last century the time began when Tirpitz set to work in order to carry out the Kaiser's words: 'The trident belongs to our hand.'

What motives had William II to increase naval construction? In the first place, megalomania and vanity. In order to satisfy these he needed a strong fleet, strong at least in numbers. Crass materialism was the driving force behind the Kaiser's every action."

Kaiser and Prince Henry.—Naval construction, intimates this German critic, was carried on by the Kaiser for his own pleasure, and entertainment. He needed the fleet as a background during the Kiel week, and as an escort during the Hohenzollern excursions. His evil influence was widespread among the officers, among whom servility to superiors, brutality to inferiors, unhealthy rivalry, love of enjoyment and bombast were encouraged. Under the Kaiser's régime luxury and good living flourished. During the war he often appeared at Kiel and Wilhelmshaven and made grandiloquent speeches. During the naval maneuvers he perpetrated practical jokes which were almost incredibly coarse and vulgar.

Prince Henry of Prussia, the ex-Kaiser's royal brother, stands equally low in the estimation of Captain Persius. He says Prince Henry was a pronounced Anglophile, most at home when strolling along Pall Mall or Piccadilly, or when, in evening dress, the guest of some English club. An interesting account is given of Prince Henry's pleasure cruise to the Far East in the German war cruiser, the *Deutschland*. Before his departure the Kaiser said to him:

"If any one should venture to offend us in our good right, then bring your mailed fist (gepanzerte Faust) into action! And, if God wills it, weave laurels around your youthful brows."

To this the prince rejoined:

"I go forth to bring to the nations the evangel of your Majesty's hallowed person!"

On this Captain Persius comments that the "gepanzerte Faust," which became world-famous subsequently in English translation as the "mailed first," referred to the *Deutschland*, an armored cruiser of an old ramshackle description and the object of much ridicule among the English.

Captain Persius was a member of the *Deutschland* party on this cruise, and came back with many uncomplimentary anecdotes of Prince Henry, which he sets down in his book. Once, while the ship was lying near Bangkok, a number of Siamese princes and dignitaries arrived in a yacht. They were decked out with all kinds of orders, and their uniforms blazed with gold. Their leader, a chocolate colored Siamese, was the worse for liquor. When Captain Persius expressed his amusement at these absurd personages, Prince Henry waxed furious, and exclaiming: "No more of this, please! Be careful what you're saying! Why, you don't seem to have the slightest dynastic feeling!" walked away in a fit of bad temper.

Tirpitz and U-Boat War.—Of Admiral von Tirpitz, the man responsible for the execution of the Kaiser's naval policy, Captain Persius writes:

"It is no exaggeration to say that, except for the few gentlemen who owed him personal gratitude, our naval officers felt no sympathy for Tirpitz. His character was generally known—his crass egoism, his domineering spirit, his megalomania, his lack of understanding for the needs of the fleet, his feebleness in the face of the bureaucracy. Known, too, were the orgies he carried on in the Marine Ministry and the way in which he failed whenever new problems in ship construction or naval artillery appeared. . . . . He failed in the precise direction in which he should not have failed—U-boats! He showed plenty of energy where less energy was needed—torpedo boats and airships. Tirpitz was often great in little things. In this respect he somewhat resembled a Prussian sergeant major . . . . The Kaiser did not find Tirpitz sympathetic (although he imagined he needed him). It was my frequent experience that he treated him contemptuously. But Tirpitz's skin was as thick as his conscience was robust. . . . . To-day no wideawake German thinks of Tirpitz except sorrowfully. . . . . Tirpitz who torpedoed German happiness, German contentment, German wealth."

Captain Persius blames Admiral von Tirpitz severely throughout for not realizing the value of the submarine; even in peace time, he says, the German Naval Command "neglected the most modern weapon, the submarine, which would have been of the highest value for us, who were the weaker at sea. The chief guilt lies with Tirpitz, who did not further the U-boat weapon before the war as interests of national defense commanded. He furthered the construction of big battleships with great ardor. And thus he created England's hostility to us, and thus he created the war."

As a consequence of von Tirpitz's misconceptions, Germany entered the war with only twenty-seven submarines. Captain Persius gives a series of figures showing the slow growth of the German submarine fleet. Not only von Tirpitz, but his successor, Admiral von Capelle, were at first opposed to U-boat construction, and when they realized the value of this weapon they advocated intensified U-boat warfare prematurely, so that when a really formidable number of submarines had been launched England had perfected her defensive measures. The unrestricted U-boat war which was opened in 1917 Captain Persius calls the greatest mistake made by the Germans after the invasion of Belgium, because it brought America into the war. In this connection he says:

"Sensible Parliamentarians opposed it. From Capelle's mouth came the words: "America—zero, zero and zero once again!' He rejected the arguments of those who pointed to possible war with America by saying that he was of one mind with his former chief Tirpitz. Even in January, 1918, he said to a representative of the *Neues Pester Journal:* 'America's military assistance is a phantom.'"

German Naval Censorship.—To the very last the German naval censorship adopted a policy of secretiveness and falsification. Captain Persius compares this policy with that of the British Admiralty, which admitted frankly all losses; the only exception to this rule was the loss of the *Audacious,* and this was admitted immediately after the armistice. In Germany all was hushed up, obscured, invented. In all cases of official announcements of naval battles in which the British and German versions conflict, Captain Persius establishes the fact that the British version was truthful and accurate, the German version untruthful and inaccurate. "The German people were bluffed and deceived until they lost all faith in their own rulers."

A case in point involved the transportation of American soldiers to the battlefields of France. To the last the German naval authorities denied that American troops were being sent. On July 5, 1917, the Rotterdam correspondent of the *Berliner Tageblatt* wired that German submarines had attacked American transports, the implication being that the attack had been unsuccessful. This wire was submitted by Captain Persius to the Staff of the German Admiralty. The reply received was as follows: "The telegram can be published only if a comment, making the news appear ridiculous, is added." The edited version, which made the message appear vague and problematic, was not accepted, and the news about the attack on American transports was suppressed altogether. Every engagement, large or small, was similarly misinterpreted or hushed up in the grossest and most childish manner. Some of the official reports quoted by Captain Persius are absurd and insulting to the intelligence of the German people. For this von Tirpitz and his successor were responsible.

The Revolution.—It is significant that the German revolution broke out first in the navy. The responsibility for this Captain Persius attributes in great part to the evil influence of the Kaiser already mentioned, his superficiality, grandiosity, love of display, and nepotism of a widespread character, as a consequence of which officers and men became mutually estranged. Though there was much inactivity during the war, the men's leave was cut down, and many irksome and unnecessary restrictions were imposed upon them. While the seamen lived on war rations, the officers reveled in luxury. Realization of the stupidity of the German naval policy

also sapped the confidence of the men, and the personality of the Kaiser widened the breach. On June 5, 1916, just after the battle of Jutland, in which the British lost 6104 men and 117,150 tons of shipping, as against the German loss of 2414 men and 60,702 tons, the Kaiser said to a delegation representing the crews of all the ships engaged, assembled on board his flagship at Wilhelmshaven:

"The English fleet has been beaten. The first mighty hammer-blow has been delivered. The halo of English world-dominion has vanished. You have opened a new chapter in the world's history. The Lord of Hosts has steeled your arms, and has cleared your eyes. Children, what you have done, you have done for our Fatherland, so that in all the future and on all seas it may have a free path for its work and all its deeds."

A very loyal old naval officer, who had taken part in the battle and was present during the delivery of the Kaiser's grandiloquent speech, made this pithy comment:

"We were laying to with our badly riddled ships. The many dead and wounded were brought to land. On the quays stood their kin clothed in black; women and children wept piteously. We were not intoxicated by victory. We knew that this was the first and last battle we could fight. We had had amazing luck, and it seemed incredible that things had gone so well for us. Then the Kaiser came on board, in high spirits, smothered in decorations, surrounded by his great entourage that distributed handshakes and congratulations right and left, smiling graciously. The Kaiser's bombastic speech and the whole ceremony were so repulsive to me that I shuddered. I shall get rid of my uniform as soon as possible."

It was episodes such as this that destroyed the confidence of the crews in their rulers. When the end of the great drama approached, and the entire German fleet was ordered to steam out and give battle—which meant annihilation—the sailors got wind of this "devilish proposal," and the news went from mouth to mouth like wildfire. "They were going to murder us, one and all, in the last moment of the war!" The men of the German navy refused to be murdered, they mutinied, the revolution began, and the whole imperial edifice collapsed like a house of cards.—*New York Times Current History,* April, 1920.

CORROSION IN WIRE ROPES.—Experience has shown that wire ropes of compound construction, subjected to corrosion influences, are likely to deceive engineers as to the strength remaining in them, says a circular issued to managers of mines on the Rand, South Africa. Where reduction of diameter or circumference of the rope has taken place, not accounted for by the evidence of wear, the part of the rope under examination should first be fully loaded and then relieved of the load. Any noticeable difference in circumference under these circumstances and the slackening of the outside wires when the load is off will indicate that internal corrosion has taken place. The extent of corrosion inside the strand can only be estimated by the slackness of the outside wires. The corrosion between the strands can be further examined by untwisting the rope or displaying the strands sufficiently with a marline spike.

Engineers are apt to imagine that reduction in the size of a rope may be due to some collapse of the hemp core. In a test at the mines department mechanical laboratory of a 1.28-inch diameter rope, the hemp core was entirely removed for about 5 feet of the length. The specimen was gradually loaded up to 30 tons, but beyond a slight increase of the lay from 10½ to 11 inches, subsiding after test to 10¾ inches, where was practically no alteration in the shape or size of the rope.

In some recent tests of corroded ropes, the results shown in the table below were obtained.

Original diameter in. Rope	Wires	Original breaking load lb.	Diameter at test in.	Breaking load at test lb.
1.50	0.099	222,208	1.41	191,960
1.50	0.099	222,208	1.40	166,660
1.50	0.099	222,208	1.30	137,260
1.50	0.099	222,208	1.23	66,880
1.50	0.102	220,000	1.22	97,260
1.25	0.115	148,700	1.23	137,660
1.25	0.115	148,700	1.00	78,920

In all the above-mentioned cases the outside wires were less than half worn, but the internal corrosion was excessive. The wires were brittle also. Experience has shown that the remarks concerning corrosion on the certificate of biannual tests are taken as merely applying to the test specimen and not considered as having a bearing on the state of the rest of the rope.—*Engineering and Industrial Management,* May 6, 1920.

PAYING WAR COSTS.—" It is of profound importance to make the millions of workers see things correctly, for they are blindly approaching a time when adverse economic conditions are going to drive them, and no socialistic rantings or paternalistic policies by the government are going to help them. The world has become so much poorer by the squandering of wealth and manpower during the war that no advance in the scale of living is to be expected from it. The prospect is just the reverse. The farmer does not lose his cattle and install improvements in his house because of his loss. The people of a city do not become profligate buyers of automobiles after a conflagration has swept away their houses. No more do nations become prosperous because war has consumed their substance. Instead of labor holding what it has gained during the war it is probable that it will suffer a relapse of a condition inferior to what it held just before the war, although the unions will struggle bravely against it. But labor is in danger of losing the eight-hour day for the simple reason that it will have to work nine to ten hours in order to produce enough on which to live."—*W. R. Ingalls, before Canadian Mining Institute.*

RUSTING OF SHIPS.—The rusting of the hulls of ships in sea-water is not an ordinary process of oxidisation, but a complex physico-chemical action that is not yet fully understood.

" Electrolytic action is set up between the iron and rust with the sea water as electrolyte as soon as the initial rust formation has taken place. This action continues as long as the liquid can penetrate between the iron and the formation of rust, and the increase of volume of the rust exerts a pressure that flakes off the surface and favors the further penetration of the rusting. At the same time as this process takes place outside the ship, rust formation occurs inside the hull in the presence of damp, so that the deterioration of the hull takes place from both sides.

" Various methods have been adopted to inhibit the rusting action. In America the iron plates are alloyed with copper, cobalt or nickel, but if the added metal does not form an alloy, but remains present as a mixture, the electrolytic action may be accentuated.

" The best protection is afforded by covering the iron with protective coatings of metal or paint. Zinc squirted on by the Schoop process is very suitable, and the paints that are used should contain rubber in solution to obtain the greatest impenetrability. Coal tar is also a good material. The selection of paints is of the greatest importance and they should be laid on in several layers. For the inside of the hull cement

capable of withstanding heat may be used. In some cases zinc protective plates are fixed in such positions as to divert the eletrolytic action from iron parts that require special protection. The author proposes that a research laboratory should be founded in Germany to study the question exhaustively." (Stauch, *Elektrotechnische Zeitschrift,* Mar. 4, 1920, 3 cols.)—*The Technical Review,* May 11, 1920.

MINING FOR OIL.—We shall in future dig most of our petroleum out of the hills in solid form, according to President Victor C. Alderson, of the Colorado School of Mines. Oil-shale, from which oil may be extracted by distillation, is the only great national reservoir that can be absolutely depended upon, President Alderson asserts. It will be the source of our oil-supply for the future, for it provides an almost unlimited supply of raw material. Its distribution is world-wide and its extent incalculable. Extensive deposits are found in Colorado, Utah, Wyoming, Nevada, Montana, and California. It abounds in Canada, in Scotland, in France, in South Africa, in New South Wales, New Zealand, Tasmania, Brazil, Italy, Spain Austria-Hungary, Serbia, and Turkey. President Alderson figures out that in his home state alone, if one hundred plants were in operation, each treating two thousand tons daily, they would have a daily production of two hundred thousand barrels, and they would have material to last them eight hundred years. Our quotations are from a paper read at the St. Louis Mining Congress by Dr. Alderson and issued in pamphlet form. We read:

"Oil-shale virtually contains no oil as such. It is a consolidated mud or clay deposit from which petroleum is obtained by distillation. In appearance the shale is black, or brownish-black, but on weathered surfaces it is white or gray. It is usually fine-grained, with some lime and occasionally sand. It is tough, but in thin sections friable. When broken to a fresh surface it may give an odor like petroleum. Thin, rich pieces may burn with a sooty flame. . . . . Oil-shale must be carefully distinguished from oil-sand. In the oil-sand the oil is contained in the sand as oil. When the sand is penetrated by a well the oil gushes out or is pumped out. In the oil-shale there is no oil as such, but only the uncooked ingredients of oil. When the shale is subjected to destructive distillation—*i. e.*, heated in a closed vessel or 'cooked,' shale-oil results as a manufactured product.

"Oil-shale is one of a long list of natural deposits which result from the deposition of organic matter from plants or animals of a former geologic era—like anthracite, bituminous, and brown coal, peat, petroleum, and asphaltum. Beds of oil-shale were laid down in lagoons, or wide expanses of quiet water. They contain a large amount of organic matter—low plant forms of lifelike algæ; also pollen, fish-scales, insects, and remains of animal and vegetable life.

"At the present time we have no exact knowledge of the change or the persistency of oil values with depth, nor the under-ground difficulties to be met in mining. Up to the present time sampling has been done on weathered outcrops or from shale close to the surface. There is reason to expect that as unaltered shale is reached it will be found to be richer than shale near the surface."

The oil-shale industry, President Alderson tells us, has been in operation in Scotland since 1850, and has met and overcome technical, trade, and economic obstacles. It seems to him a mere matter of common sense for the pioneers of the industry in the United States to follow the methods of Scotland; to adapt them to our conditions, and then to improve them as fast as possible. Besides the production of crude oil, gas, and ammonium sulfate, he suggests that the nitrogen may be reclaimed in a form for use in the manufacture of munitions of war; aniline dyes and flotation oils may be obtained; possibly producer gas, a substitute for rubber, and other products may become valuable. All in all, he says, the oil-shale industry presents a long series of problems to be solved by trained men. The in-

dustry can be classed as a combined mining-chemical-manufacturing project. To quote further:

"In mining oil-shale, steam-shovel methods may be eliminated for the present. Beds of shale amenable to such treatment are far removed from railroads or are on the top of high cliffs. To reach these beds expensive roads would have to be constructed and the first cost of installation would be excessive. In the next place, the long-wall system of coal-mining can be eliminated, because under that method the roof is allowed to cave in after mining and this would destroy any beds of shale lying above the one being mined. The room-and-pillar method of coal-mining will probably be adopted. . . . . A large percentage of shale must be left, but this is inconsequential on account of the great extent of the deposits. It goes without saying that to open an oil-shale deposit properly a definite plan of development must be outlined, mechanical ventilation supplied, provision made for rapid and economical haulage, and the numerous appliances provided for handling a very large tonnage in an efficient and economical way. The open-cut method may be used in some favorable localities. . . . .

"The oil-shale industry has a variety of phases and is consequently a complex industry. The mining of shale will probably present no problems of a troublesome character. The crux of the industry is, however, in the restoring—*i. e.*, in the conversion of the shale into oil and gas. The specific problem is to apply heat to the retort at such a temperature and with such uniformity that not only will the maximum yield be produced, but that the oil will be of a suitable character for the succeeding process of refining. On this problem American ingenuity is at work. Already about 20 processes are in course of development.—*The Literary Digest,* May 22, 1920.

FUEL ECONOMY IN GERMANY.—The author takes as his text an article contributed to the *Frankfurter Zeitung* by Otto Alt, in which it is proposed to submit the bulk of the coal raised in Germany to a special process of low temperature distillation.

"Liquid fuel thus obtained could be used in Diesel engines and the other by-products obtained (including ammonia, benzine and lubricating oil) would be of great value in industry. The low temperature distillation processes in question are applicable to the lignite as well as to the hard coal of Germany. Distillation at temperatures as low as 600° C. yields tar of quite different composition and properties from those of ordinary coal tar, and the yield of the low-temperature tar is from 8 to 12 per cent of the weight of raw coal, compared with from 4 to 5 per cent of ordinary coal tar in high temperature distillation.
ucts from coal distilled at 1800° F. and at 800° F., respectively. A brief
"A table is presented showing the average quantities of various by-prod-
comparison is made between the thermal efficiency of Diesel engines and steam installations, and it is estimated that by using Diesel locomotives instead of steam locomotives about 75 per cent of the coal consumption of railways would be saved. In conclusion, the author criticises the superpower station scheme proposed for this country, principally on the ground that the stations are to burn raw coal without utilising the valuable byproducts which might be recovered. Also, most of the heat developed by this coal will be rejected (via the condensing water) to the rivers of the country." (D. Brownlie, *Manchester Guardian,* Apr. 6, 1920. 2 cols.)—*The Technical Review,* May 11, 1920.

SUCCESSFUL CANALS.—Suez: 100 miles from Mediterranean to Red Sea. Original depth 20 feet, present 30, ultimate probably 40. First year, 1870, vessel passages, 500; maximum, 1914, vessel passages, 4800; tonnage, 26,000,000. It cuts off 2000 to 3000 miles from the Oriental voyage. It paid.

Panama: 41 miles from Caribbean to Pacific. Elevation of 85 feet overcome by three locks, 1100 by 100 feet. Depth of channel, 45 feet. First year, 1915, vessel passages, 1317; tonnage, 4,600,000. It cuts off 1500 to 2500 miles from the coast to coast voyage. It cost $400,000,000. It pays.

Manchester: 35 miles from Mersey estuary to inland port. Original depth 26 feet, now 28. Foreign trade of port, first year, 1894, $34,500,000; foreign trade, 1911, $270,500,000. It eliminates transfer at Liverpool and short rail haul. It cost over $100,000,000. It pays.

Hamburg: 85 miles from the sea by River Elbe. Original depth low water 6.5 feet; in 1911, depth low water, 26 feet, high water, 32 feet. It made Hamburg the chief port of Germany. It paid.

The Soo: 10 miles from Lake Superior to fairway in St. Mary's River. Original depth, 11.5 feet; present depth, 20-21 feet in channel, 24.5 feet in locks. Maximum traffic, 1916, vessel passages, 25,407; tonnage, 91,800,000. It extends the lower lakes 400 miles westward, Superior 600 miles eastward. It pays.

The St. Lawrence: 46 miles to be rectified. Depth to be recommended by engineers. Cost to be estimated by engineers. It will extend the Great Lakes System to the seven seas. It will pay.—*Shipping*, May 10, 1920.

MEXICAN SITUATION.—Business men and political leaders are asking about the new men who are reported to be in control of Mexico. Some of the names are unknown to the State Department, while, all of the men are young and untried. To have our nearest neighbor, with its 14,000,000 people, suddenly fall into the hands of these young radicals, makes one realize that we are living in perilous times. *It emphasizes the importance of giving political positions only to men of the highest character, Christian men who stand for righteousness.*

We cannot vouch for the character of Gonzales, Alvarado, De la Huerta, Obregon, and these other Mexican leaders. The way Carranza was killed suggests that they are no better than their predecessors. Other information leads us to believe that these are the better young men of the recent Mexican leaders and that more may be expected of them than of any previous group. Let us hope they will not get fighting among themselves. Certainly the oil, gold, and other natural resources of Mexico have brought the nation trial and tribulation.—*United States Bulletin*, May 31, 1920.

CURRENT NAVAL AND PROFESSIONAL PAPERS

Speculation I (Possibilities of the Transport Tank and Operation of Large Tanks in Warfare Ashore Somewhat after the Methods of Naval Tactics). *Journal of the Royal United Service Institution*, Feb., 1920.

The Relation of the U. S. Naval Observatory to the Navy and Shipping Interests of the Country. By Rear Admiral J. A. Hoogewerff. *Franklin Institute*, April, 1920.

The Physics of Flight. *Franklin Institute*, May, 1920.

German Submarine Mine Layers. *The Engineer*, April 23, 1920.

H. M. S. *Hood*. *Institution of Naval Architects*, March, 1920.

German Submarines. *Institution of Naval Architects*, March, 1920.

Mechanical Reduction Gears in Warships. *Institution of Naval Architects*, March, 1920.

The annual number of *The Shipbuilder* for 1920, published in May, 1920, contains digests of many important nautical articles published in all parts of the world during the previous twelve months. The entire number is highly recommended.

NOTES ON INTERNATIONAL AFFAIRS

FROM MAY 10 TO JUNE 10

PREPARED BY

ALLAN WESTCOTT, Associate Professor, U. S. Naval Academy

KNOX PEACE RESOLUTION VETOED

The Knox Resolution declaring war with Germany at an end and providing for separate negotiations with that country passed the Senate by a vote of 43 to 38, and the House by a vote of 228 to 139, 19 Democrats supporting and 2 Republicans opposed.

On May 27 President Wilson vetoed the resolution and returned it to the House with a note in which he declared that such a peace as the resolution provided "would place an ineffaceable stain upon the gallantry and honor of the United States," and would accomplish none of the essential purposes for which we entered the war. The President's veto was fully anticipated. Interest thereafter centered in the attitude to be taken by the two parties regarding the League of Nations in the coming Presidential campaign.

PRESIDENT PROPOSES ARMENIAN MANDATE.—On May 24 President Wilson sent a special message to Congress urging that it grant to the Executive power to accept for the United States the mandate over Armenia offered by the Supreme Council at San Remo. The President in his message referred to the Senate resolution of May 14 congratulating the Republic of Armenia upon its recognition by the Allied Powers and the United States, expressing sympathy with the sufferings of its people, and requesting that an American war vessel be stationed at the port of Batum.

The President recognized the far-reaching significance of acceptance of the mandate, but urged it as a duty for the maintenance of peace and tolerable living conditions in territories separated from the former Turkish Empire. He referred to the report of the American Military Mission headed by General James G. Harboard which estimated that acceptance of the Armenian mandate would call for two divisions of American troops amounting altogether to 60,000 officers and men, and would cost $700,000,000 for a period of five years. The report suggested, however, that it might be better to spend "millions for mandates than billions for future wars."

SENATE REJECTS MANDATE.—The Senate Foreign Affairs Committee by a vote of 11 to 4 reported to the Senate a resolution briefly declining to grant the President power to accept the Armenian mandate. This reso-

lution was passed by the Senate. The House declined to consider the question, on the ground that the Senate action was sufficient.

PRESIDENT TO FIX ARMENIAN BOUNDARY.—Washington, May 22.—President Wilson, it was officially announced this afternoon, has accepted the invitation of the Allied Powers to act as arbitrator for the settlement of the Armenian frontier disputes.

In assuming the responsibility, the President has accepted the suggestion of the San Remo conference that he do so without regard as to what the attitude of the United States ultimately may be concerning their proposal that this country also undertake the mandate over Armenia.

It is assumed that he will appoint one or more commissioners or investigators to collect the necessary data, and probably to grant hearings to representatives of the various interested powers, including Armenia, Turkey, France, Greece and Italy.

The question of fixing the boundaries of Armenia has been one of the most troublesome in connection with the negotiation of the Turkish treaty. Although the United States is not a party to this treaty, since it was not at war with Turkey, the President has repeatedly insisted that the boundaries of the new Armenian state should be such as to guarantee its integrity from aggressions by hostile Turks and Kurds and at the same time assure the country's economic development. When he raised objections to the last draft of these boundaries drawn up by the Allied and Turkish negotiators the Allied Powers insisted that he should assume the responsibility of arbitrating the exact lines.—*Baltimore Sun*, May 23.

ALLIED PREMIERS TO FIX GERMAN INDEMNITY

SPA CONFERENCE POSTPONED.—The Allied-German Indemnity Conference which was to have been held at Spa on June 21 has been postponed until July 5, on account of the elections in Germany.

PRELIMINARY ALLIED CONFERENCES.—According to press statements of July 17 the Anglo-French Conference at Hythe fixed the sum total which Germany should be called upon to pay in reparation at 120 billion marks gold—about 28½ billion dollars. It was also decided, according to reports, that Germany would be permitted to issue bonds covering the indemnity, which the Allied Powers could use in paying their own debts to the United States and other creditors.

According to an agreement of last December the German indemnity was to be divided as follows: 55 per cent to France, 15 per cent to England, 10 per cent to Belgium, 7 per cent to Italy, and the remainder to other Allied states. Italy has recently expressed dissatisfaction with this apportionment on the grounds that she did not share in the division of German battleships or colonies, and that the distribution of the indemnity should be based not on the actual losses but on the efforts expended in the war. To settle this question of distribution and reach final agreement on the terms to be presented to Germany, the French and British Premiers will confer in Paris on June 20, and a financial conference will meet in Brussels July 2-4.

It is uncertain whether or not the United States will be represented at this meeting. President Wilson will probably be called upon to confirm the statement that the United States will demand no share in the indemnity.

LEAGUE OF NATIONS

FIFTH SESSION AT ROME.—The fifth session of the League of Nations Council met at Rome on May 14, electing Signor Tittoni, President of the Italian Senate, as president of the session. The Council discussed whether President Wilson should be requested to convoke the First Assembly of the League, which is expected to be held in the autumn.

It was decided that a note should be sent to Russia expressing regret that the Soviet Government laid down conditions amounting to a refusal to permit a League Investigating Commission to visit Russia. To this communication Foreign Minister Tchitcherin later sent a reply expressing extreme astonishment that one of the members of the League—Poland—should be allowed by other members "full freedom to violate the peace and strangle justice by trying to convert the Ukraine into a vassal state," and stating that in view of Polish hostilities the reception of a League Commission was impossible.

PERSIA APPEALS TO LEAGUE.—A special meeting of the League Council was set for June 14 in London to consider difficulties arising out of the plebiscites in Schleswig and Upper Silesia, and also to consider Persia's protest to the league regarding Bolshevist attacks on the Persian port of Enzeli on the Caspian Sea. The Persian appeal was sent on May 21. It appears that naval vessels belonging to the anti-Bolshevist forces of Gen. Denikin had taken refuge at Enzeli and that the Bolshevists had bombarded and occupied the port. There were rumors also that Bolshevist forces had entered the Persian capital of Teheran, not far distant. The British Foreign Office later announced that the Russian occupation of Enzeli was only temporary and that the forces would soon be withdrawn.

LACK OF ENTHUSIASM FOR LEAGUE.—Persia's appeal to the league will add piquancy to the controversy which has arisen over the attitude of the British Government to the league. Accusations of luke-warmness have been made and it was suggested in reply that some of the zeal of the league champions was inspired by their distrust of Poland and they might not so eager if it had been Persia and not Soviet Russia on whose behalf the league would act.

Lord Robert Cecil, whose single-minded enthusiasm for the league ideal is universally recognized, has, however, returned to the charge to-night in a signed article in *The Evening Standard*. He says:

"I am profoundly convinced that at present the League of Nations is quite ineffective for the purpose for which it was formed, namely, the prevention of war. That does not mean that it could not be made effective. On the contrary I think it could be made so but it must be worked by people who really believe in it."

He then maintains that the need both Russia and Poland feel to resume economic relations with the powers forming the council of the league puts "an immense power" in its hands and goes on:

"The real question is: Are the government in earnest in carrying out with all the power of the British Empire behind them the covenant into which they have entered both in spirit and in letter? If they are, Great Britain can in this respect lead the world, as it has led the world before. If the same energy and conviction were thrown into the meetings of the council of the league as are thrown into the meetings of the Supreme Council the league would soon be in a very different position from that which it occupies to-day."—*N. Y. Times*, May 22.

ONLY FOUR NATIONS OUTSIDE LEAGUE.—Washington, June 7.—It was pointed out at the State Department to-day that the adherence of Haiti to the covenant of the League of Nations on June 2 left only Honduras, Costa Rica, China and the United States, of the nations eligible for membership in the league at the present time, outside that organization.

Of these, it was stated, China had not ratified the Treaty of Versailles because of her objection to what she considered the injustice of the transfer of Shantung to Japan. In order, however, to gain admission to the league, China contemplates ratification of the Austrian peace treaty.—*N. Y. Times*, June 8.

AMERICAN DELEGATES TO CONFERENCE ON INTERNATIONAL COURT.—On June 1 Mr. Elihu Root with a corps of assistants sailed for the Hague to attend a conference of legal experts called by the Council of the League of Nations to formulate plans for the establishment of a Permanent Court of International Justice as provided by Article 18 of the League Covenant.

AUSTRIA AND HUNGARY

HUNGARY SIGNS PEACE TREATY.—The Hungarian Peace Treaty was signed at Versailles on June 4, Ambassador Wallace affixing his signature to the Treaty and the League Covenant on behalf of the United States. This treaty, like that with Germany, will now come up for ratification by the signatory powers. Hungary had considerable difficulty in finding envoys willing to accept the unpleasant task of signing the terms, but finally sent August Beymar, Minister of Labor, and Alfred Lazar, Minister Plenipotentiary.

AUSTRIAN FINANCES UNDER ALLIED CONTROL.—Paris, June 4.—"Chancellor Renner," the Paris *Temps* says, "has communicated to the Budget Commission of Parliament a note signed by M. Klobukowski and Sir William Goode in the name of the Reparation Commission, Vienna section, on which they represent France and England. This note announces officially to Austria the aid which the Entente Powers are giving to the economic resurrection, and authorizes the issue of Treasury bonds, for which the public property and all the revenues of Austria will serve as guarantee with regard to all foreign obligations, including war debts and reparations.

"These Treasury bonds will cover credits for food and raw materials already accorded, or which will be accorded; but the Reparation Commission will, first of all, have control of the finances of Austria. It will be eventually able to take in hand the imposition of taxes and will assure strict economy in state expenditures.

"Chancellor Renner has announced the imminent going into effect of a state of peace after the ratification by France of the Treaty of St. Germain. He has expressed the gratitude of the Austrian people for the assistance of the Entente and the hope that Austria will find in the Reparation Commission a benevolent tutor."—*N. Y. Times*, June 8.

GERMANY

EXTREMES GAIN IN GERMAN ELECTIONS.—Early returns from the elections in Germany on June 5 show gains for both Radicals and Reactionaries at the expense of the "middle parties"—the majority Socialists and Democrats. As a result the present coalition government will probably secure only a bare majority in the Reichstag, insufficient to guarantee its

retention of power. An intense struggle for political control is expected between the parties of the right and of the left. The elections show that the propertied classes in Germany are coming back as a strong factor in politics. They also reveal the weakness of the extreme radical or communist party, which polled a very light vote. Partial returns give the following results:

	Votes	Seats
Independent Socialists	3,648,000	57
Majority Socialists	3,523,000	86
German People's Party	2,637,000	42
Democrats	1,627,000	27
German Nationalists	2,172,000	41
Centrists	1,804,000	43
Communists	329,000	2
Scattering		47

RUSSIA

LONDON CONFERENCE ON TRADE WITH RUSSIA.—The first official discussion between British ministers and the Russian trade delegation headed by Gregory Krassin were held in London on May 31. Krassin was given a favorable reception by London crowds.

According to the French press, the French Government is leaving to Great Britain sole initiative and responsibility for the negotiations with Russia. The French declare Russia has nothing to export, and is seeking to spend gold which belongs rightly to Russia's creditors, to Ukraine, and to Rumania. Russia's eagerness for assistance, they assert, is the outcome of Polish military successes; and England's eagerness to negotiate arises from fear of Russian activities on the Persian frontier.

London, June 3.—Trade negotiations between the Allies and Gregory Krassin, Russian Soviet Minister of Trade and Commerce, have not yet begun, according to a statement by Premier Lloyd George in the House of Commons to-day.

Replying to a flood of insistent queries, the Premier said there were certain questions Great Britain wanted cleared out of the way before it would undertake negotiations at all. Russia must guarantee that there will be no attacks on British interests in the east or at home while negotiations are proceeding, Mr. Lloyd George declared, and must guarantee to release all British prisoners, whether civil or military. Great Britain must clear these questions out of the way herself, after which allied negotiations could proceed.

Representatives of the French and Italian governments were in London, the Premier added.

The Premier was asked whether the negotiations had been sanctioned by France and Italy. The question of M. Krassin's credentials and whom he represented also was raised.

The Premier replied that the decision of the Supreme Council to promote trade with Russia already had been made public. At San Remo the Supreme Council decided to authorize Allied representatives to meet M. Krassin and a Rusian trade delegation, excepting Maxim Litvinoff, in London as soon as possible.

The Premier said M. Krassin was head of the delegation representing the Russian Co-Operative Organization, but he was also Minister of the Soviet Government and as such, no doubt, was acting in the name and under the authority of the Soviet Government.

One of the members asked whether Krassin was not originally a German agent. The Premier said he did not think he was, but that he was associated with a German firm of electricians. He was a Russian.

"I am not aware," said the Premier, "that there is great perturbation in France. The mere fact that some French newspapers are trying to foment trouble between two friendly and allied countries, whose friendliness is essential in the interest of the world, is no proof of the French perturbation."—*N. Y. Times*, June 4.

ITALY AND SCANDINAVIA REOPEN TRADE.—According to an Italian report of May 21 Italy was about to send 30 million lire's worth of medical supplies to Russia in exchange for grain, the transport to be effected via the Black Sea.

Contracts with Sweden amounting to 100 million Swedish kroner have also been negotiated, and Danish firms have sold large quantities of agricultural machinery, seeds, and medical supplies, including 500,000 kroner's worth of scythes.

HARD FIGHTING WITH POLAND.—During the last two weeks of May the Soviet Government attempted an offensive against Poland on a considerable scale on the north or Beresino front. According to despatches of early June, Poland had held up the Russian advance and was replying with a vigorous counter-offensive.

ITALY

NITTI CABINET REORGANIZED.—On May 1 the Nitti Cabinet based on a makeshift combination of Socialists and Catholics sustained defeat in Parliament by a vote of 193 to 172. After considerable delay Signor Nitti was asked by the King to attempt the formation of a new ministry.

During his premiership Nitti established friendly relations with Austria, cemented by the visit of the Austrian Chancellor Renner to Rome. Nitti also was successful in imposing severe taxes on property and collected 20 billion lire in subscriptions to the last national loan. In international policy he stands for peace and trade with Russia, and maintenance of the Ottoman Empire. His views on Italy's internal politics are given in the June *Current History* as follows:

We have three political factors to consider—Nationalism, Socialism and Catholicism. Nationalism is a fictitious movement which will disappear the day the masses understand that, the war being won, we have secured our natural geographical limits, or at least, what has been the legitimate aspiration of many generations in Italy. Fiume is the last page of our patriotic history, which, if we are patient enough, we shall inscribe with the same pride as all the rest.

Socialism will not constitute a menace. Most of those who profess it are statesmen, or, rather, men of practical possibilities, who will before long separate from those agitators who have no practical end in view, while the latter will stand discredited in the eyes of the Italian public, which is supremely realistic.

Political Catholicism is a force of social conservation which is especially useful in Italy at this time. The question of temporal power exists only in form, and even in this respect will soon disappear. There will be no need for a great declaration, nor for pompous renunciation, nor for revisions of the past; it will fall like all decaying things. One fine day, without knowing how, we shall come to an understanding. Cardinals will enter

our Senate, the Pope will send us a Nuncio, and we will reply by sending an Ambassador to the Pope. To the head of this great organization, which is the Catholic Church, we give all due respect and extend to him all the rights and privileges to which history entitles him; and with the fulfillment of that duty he will have no desire to dispute with us the right of having our own country. The Cavournian formula of a Free Church in a Free State will be adopted for mutual convenience.

TURKEY

PEACE TREATY SUBMITTED.—The Peace Treaty with Turkey was presented to the Turkish delegates at Paris on May 11. The terms of the treaty have already been summarized in previous issues of these notes. They provide for American membership, if desired, on the commission to control navigation of the Dardanelles, the other delegates being supplied by France, Italy, Great Britain, Japan, Greece, Rumania, and perhaps later Russia and Bulgaria. The United States, Great Britain, France, Italy, Japan, and Russia will have two votes each. The new Turkey in Europe consists of an area 37 miles by 25 miles east of the Enos-Midia line. In Asia Minor Turkey loses Smyrna and its hinterland to Greece, the Armenian republic, and all her former possesions east of the Mediterranean.

TURKISH NATIONALISTS ACTIVE.—According to dispatches of early June, the Nationalist forces under Kemal Pasha had inflicted defeat on most of the Sultan's troops in Asia Minor and occupied positions at Kum Kale, at the mouth of the Dardanelles, and along the Sea of Marmora. Here on June 3 they were bombarded by British naval vessels. French forces in Asia Minor were reported to be withdrawing within the Syrian frontier and concentrating at Aleppo.

In Thrace, Bulgarians joined Turks to resist Greek occupation of the territory assigned Greece by the treaty. It was the American proposal that Bulgaria should receive a part of this territory with an outlet on the Ægean. The new Balkan alignment is likely to be Turkey and Bulgaria against Rumania and Greece.

MEXICO

MURDER OF CARRANZA.—At 4 o'clock on the morning of May 20 President Carranza was murdered at the village of Talxcalantongo in Pueblo, during his flight from Obregon forces. The murder was committed apparently for motives of personal vengeance by General Herrero, to whom Carranza had entrusted himself. The followers of Carranza made some efforts at defense, but were taken by surprise. The body of the ex-president was afterward brought to Mexico City. Gen. Herrero was captured and put under arrest.

Officials of the Obregon government made every effort to clear themselves of complicity in the murder of Carranza, which might otherwise influence the United States against recognition of the new régime.

PROVISIONAL PRESIDENT SELECTED.—On May 24 the Mexican National Congress, under Obregon control, elected General Adolfo de la Huerta as provisional president. General Huerta organized a ministry composed of Obregon followers.

REPORT OF MEXICAN SENATE COMMITTEE.—Washington, May 31.—The Sub-Committee of the Senate Committee on Foreign Affairs, which, under the chairmanship of Senator Fall, has carried out an extended inquiry into Mexican affairs, reported to-day to the full Foreign Affairs Committee a recommendation that a new treaty be entered into between this country and Mexico by which "practices now authorized by the Mexican Constitution" shall be abandoned and the lives and property of Americans in Mexico shall be safeguarded before the United States recognizes the new government in Mexico.

If such an agreement cannot be reached between the two countries and Americans continue to suffer the committee recommeends that we "send a police force consisting of the naval and military forces of our government into the Republic of Mexico to open and maintain open every line of communication between the City of Mexico and every seaport and border port in Mexico."

Having obtained the assurances and recognized the government, the Fall Committee favors generous loans to Mexico to meet the public debt and rehabilitate the railroads.—*N. Y. Times*, June 1.

FAR EAST

RENEWAL OF ANGLO-JAPANESE TREATY.—London, May 31.—The *Pall Mall Gazette* says to-day that the question of renewal of the Anglo-Japanese alliance has not yet reached the stage in which its consideration by the British Cabinet has become imperative.

The newspaper says it believes Premier Lloyd George favors utilizing the occasion of renewal to help forward the principle of disarmament.

Efforts will be made in the next few weeks to solve the difficulties between the United States and Japan, the *Pall Mall Gazette* adds, after which the possibility of widening the scope of the treaty to include the United States would be much less remote than appears to-day.

Tokio, May 29.—(Associated Press.)—The Cabinet yesterday decided to open negotiations for a renewal and revision of the Anglo-Japanese alliance, which Great Britain is said to be willing to maintain with modifications, according to the *Yomi-Uri Shimbun* to-day. Though some of the covenants will be changed to harmonize with the League of Nations, the newspaper says it believes there will be no alteration of the principle with regard to safeguarding the peace of Eastern Asia and India and the integrity of China and the maintenance of the respective rights and special interests of Japan and Great Britain in the Far East.

Marquis Shigenobu Okuma, former Premier, has issued a statement saying that although the downfall of Russia and Germany has removed the original positive reasons for the alliance, the uncertain conditions in China and Siberia and the agitation on the part of the Mohammedans of Southern Asia make a renewal of the pact desirable as a negative instrument of peace.

A Tokio dispatch of May 28 quoted the *Asahi* as saying Baron Gonsuke Hayashi, the new Japanese Ambassador to Great Britain, would take up negotiations for a renewal of the Anglo-Japanese alliance immediately upon his arrival in London.—*N. Y. Times*, June 1.

REVIEW OF BOOKS

ON

SUBJECTS OF INTERNATIONAL AFFAIRS

"The Battle of Jutland." By Commander Carlyon Bellairs, M. P. 303 pages; with maps and diagrams. (Published by Hodder and Stoughton. London; George H. Doran Company, New York.)

The sub-title of Commander Bellairs' book is "The Sowing and the Reaping of the British Navy," which indicates the character of the treatment. Commander Bellairs has been a life-long student of British naval affairs and has written many trenchant articles on naval policy, organization, administration and doctrine as practiced in the British Navy. His book on the Battle of Jutland is a powerful and well-developed arraignment of the mode of thought that was dominant in the years of preparation leading up to the war, in the conduct of naval operations during the war, and in the battle itself. In fact, the conduct of the battle is dealt with as the logical outcome of the control of British naval affairs by what the author refers to as the "material" school. Point is given to his remarks by the fact that he stated in an article, written many years before the war, that the doctrine of war held by the senior officers of the British Navy would result in the next naval battle being indecisive.

The Battle of Jutland and the years leading up to it are subjected to close examination and thorough analysis, the salient incidents thereof being held to show wherein the "material" school failed, as it was forecasted to fail. Admiral Jellicoe and his chief "backer," Lord Fisher, are dealt with as the leading exponents of the "material" school; most of the bases of criticism are drawn from Admiral Jellicoe's own statements. The arraignment of the lack of perspective, ineffective policies, defective measures and indecisive results is very ably done; the statements appear to be correct, the logic sound, and the treatment carries conviction.

The book closes with a forceful plea for a proper "war staff"; in fact, the book is inscribed by the author as "dedicated without permission to the man who will give the Royal Navy a real war staff." His presentation of the case for the "war staff" is well done and appears to be unanswerable.

The chapter-headings give a good idea of the method of treatment:-- Policy and Preparation; The Hush-Hush Policy; The Material and Historical Schools; Tactical Thought—Jellicoe Period; The Offensive: The Command in War; Final Reflections on Preparation; A Summary of the Chief Moves; The Threshold of Battle; Beatty Delivers the High Seas Fleet to His Chief; The Theory of Deployment; The Grand Fleet Nibbles But Does Not Bite; Eleven Destroyers Dismiss Twenty-seven Battleships; The Torpedo at Jutland; The Night Action; Losses At and From Jutland; The War Staff; Conclusion; Appendix Containing Chronology of the Battle.

This critical survey of the British Navy in preparation for war and during the consequent conduct of war, merits the careful attention of every naval officer who ever expects to be present in a fleet action.

E. J. K.

NOTICE TO MEMBERS

More members, both regular and associate, are desired. Any increase in membership invariably means a larger number of articles submitted, and consequently an improvement in the PROCEEDINGS.

You are requested to send or give the attached slip to some one eligible for membership, urging him to join.

By direction of the Board of Control,

S. A. TAFFINDER,
Secretary-Treasurer.

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Secretary and Treasurer,
U. S. Naval Institute,
Annapolis, Md.

Dear Sir:

Please enroll my name as a {subscriber / regular member / associate member} of the U. S. Naval Institute from..............................

Very truly yours,

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For eligibility as to membership and for difference between members and subscribers see opposite page (Constitution).

Members are liable for dues until the date of the receipt of their resignations in writing.

Kindly check amount of remittance sent.

Membership dues (annually)		**$3.00**....
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NOTICE

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It is now in its forty-seventh year of existence. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers upon subjects of interest to the naval profession, as well as by personal support.

On the subject of membership the Constitution reads as follows:

ARTICLE VII

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control. To be declared elected, they must receive the affirmative vote of three-quarters of the members represented at regular or stated meetings, either in person or by proxy.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control. The Board of Control will at each regular meeting ballot on the nominations submitted for election, and nominees receiving a majority of the votes of the board membership shall be considered elected to membership in the United States Naval Institute."

Sec. 8. The annual dues for regular and associate members shall be three dollars, all of which shall be for a year's subscription to the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, payable upon joining the Institute, and upon the first day of each succeeding January. The fee for life membership shall be forty dollars, but if any regular or associate member has paid his dues for the year in which he wishes to be transferred to life membership, or has paid his dues for any future year or years, the amount so paid shall be deducted from the fee for life membership.

ARTICLE X

Sec. 2. One copy of the PROCEEDINGS, when published, shall be furnished to each regular and associate member (in return for dues paid), to each life member (in return for life membership fee paid), to honorary members, to each corresponding society of the Institute, and to such libraries and periodicals as may be determined upon by the Board of Control.

The PROCEEDINGS are published monthly; subscription for non-members, $3.50; enlisted men, U. S. Navy, $3.00. Single copies, by purchase, 30 cents; issues preceding January, 1920, 50 cents.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ARTICLE, 1921

A prize of two hundred dollars, with a gold medal, and a life-membership (unless the author is already a life member) in the Institute, is offered by the Naval Institute for the best original article on any subject pertaining to the naval profession published in the PROCEEDINGS during the current year. The prize will be in addition to the author's compensation paid upon publication of the article.

On the opposite page are given suggested topics. Articles are not limited to these topics and no additional weight will be given an article in awarding the prize because it is written on one of these suggested topics over one written on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. All original articles published in the PROCEEDINGS during 1920, which are deemed by the Board of Control to be of sufficient merit, will be passed upon by the Board during the month of January, 1921, and the award for the prize will be made by the Board of Control, voting by ballot.

2. No article received after November 1 will be available for publication in 1920. Articles received subsequent to November 1, if accepted, will be published as soon as practicable thereafter.

3. If, in the opinion of the Board of Control, the best article published during 1920 is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention," or such other distinction as the Board may decide.

4. In case one or more articles receive "Honorable Mention," the writers thereof will receive a minimum prize of seventy-five dollars and a life-membership (unless the author is already a life member) in the Institute, the actual amounts of the awards to be decided by the Board of Control in each case.

5. It is requested that all articles be submitted typewritten and in duplicate; articles submitted written in longhand and in single copy will, however, receive equal consideration.

6. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

S. A. TAFFINDER,
Commander, U. S. N., Secretary and Treasurer.

TOPICS FOR ARTICLES

SUGGESTED BY REQUEST OF THE BOARD OF CONTROL

"Rebuilding the Navy's Enlisted Personnel, and Reestablishing Its Morale and Spirit After the Serious Slump Caused by too Rapid Demobilization and High Wages in Civil Life."
"The Human Element in the Administration of Discipline."
"A Demobilization Programme for the Future."
"The Mission of the Naval Academy in the Molding of Character."
"Health of Personnel in Relation to Morale."
"Physical Factors in Efficiency."
"The Naval Officer and the Civilian."
"Naval Bases, Their Location, Number and Equipment."
"Military Character."
"The Ability to Handle Men a Necessary Element in the Equipment of a Naval Officer."
"The Relation of Naval Communications to Naval Strategy."
"The Relation of Naval Communications to Naval Tactics."
"The Training of Communication Officers."
"The Organization of a Naval Communication Service."
"The Naval Policy of the United States."
"A Review of the Battle of Jutland with Lessons to be Learned Therefrom."
"Modification in the Design and Armament of Ships to Meet the New Conditions of Aerial and Subsurface Attack."
"Coordination of Surface, Subsurface and Aerial Craft in Naval Warfare."
"Our New Merchant Marine."
"Submarine Warfare, Its History and Possible Development."
"Escort and Defense of Oversea Military Expeditions."
"A Proposed Building Programme for the U. S. Navy, Including an Efficiency Air Service."
"Naval Organization from the Viewpoint of Liaison in Peace and War Between the Navy and the Nation."
"The Ship's Company—Its Training, Discipline and Contentment."
"The Principles of Leadership of Naval Personnel."
"Morale Building."
"The Value of Facility in Exposition—Verbal and Written—for Naval Officers."
"Discipline as Affected by the Human Relation."
"The Value of Pep."
"Navy Spirit—Its Value to the Service and to the Country."
"The Influence of the Term of Enlistment on the Efficiency of the Service."
"The Principles upon which Should be Founded the Freedom of Neutral Shipping on the High Seas."
"The Fighting Fleet of the Future."
"The Future of the Naval Officer's Profession."
"The Navy: Its Past, Present and Future."
"The Navy in Battle: Operations of Air, Surface and Underwater Craft."
"Shall I Remain in the Navy?"
"Psychology and Naval Efficiency."
"The Naval Policy of the United States in the Light of the Peace Treaty."
"Scope of Naval Industrial Activity and the Navy's Relation to Shore Industry."
"The Pacific Theater."
"Was Germany's Coast Impregnable?"
"Future Development of the Naval Shore Establishment."
"America as a Maritime Nation."
"Arguments for and against the Restriction of the Manufacure of Munitions to Government Owned Factories."
"The Present Rule of Neutrality regarding Contraband and Blockade—Is it Justifiable in Ethics or in Expediency?"
"The United States Navy and the League of Nations."
"Is a League of Nations *Navy* Desirable?"
"The Adaptability of Oil Engines to all Classes of War Vessels."
"The Place of Mines in Future Naval Warfare and the Rules under which Their Use Should be Allowed."
"The Use and Abuse of the Doctrine of Continuous Voyage."
"The Question of the Future Use of Submarines."

LIST OF PRIZE ESSAYS

"WHAT THE NAVY HAS BEEN THINKING ABOUT"

1879

Naval Education. Prize Essay, 1879. By Lieut. Commander A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut. Commander C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881

The Type of (I) Armored Vessel, (II) Cruiser Best Suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882

Our Merchant Marine: The Causes of Its Decline and the Means to Be Taken for Its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut. Commander F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883

How May the Sphere of Usefulness of Naval Officers Be Extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CUIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886

What Changes in Organization and Drill Are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887

The Naval Brigade: Its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888

Torpedoes. Prize Essay, 1888. By Lieut. Commander W. W. Reisinger, U. S. N.

1891

The Enlistment, Training and Organization of Crews for Our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892

Torpedo-boats: Their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894

The U. S. S. Vesuvius, with Special Reference to Her Pneumatic Battery. Prize Essay, 1894. By Lieut. Commander Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut. Commander Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A Proposed Uniform Course of Instruction for the Naval Militia. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

Torpedoes in Exercise and Battle. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

Our Naval Power. Honorable Mention, 1898. By Lieut. Commander Richard Wainwright, U. S. N.

Target Practice and the Training of Gun Captains. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.

1900

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

The Automobile Torpedo and Its Uses. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903

Gunnery in Our Navy. The Causes of Its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A Naval Training Policy and System. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

Systematic Training of the Enlisted Personnel of the Navy. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

Our Torpedo-boat Flotilla. The Training Needed to Insure Its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904

The Fleet and Its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A Plea for a Higher Physical, Moral and Intellectual Standard of the Personnel for the Navy. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

The Department of the Navy. Honorable Mention, 1905. By Rear Admiral Stephen B. Luce, U. S. N.

1906

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut. Commander A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

1907

Storekeeping at the Navy Yards. Prize Essay, 1907. By Pay Inspector John A. Mudd, U. S. N.

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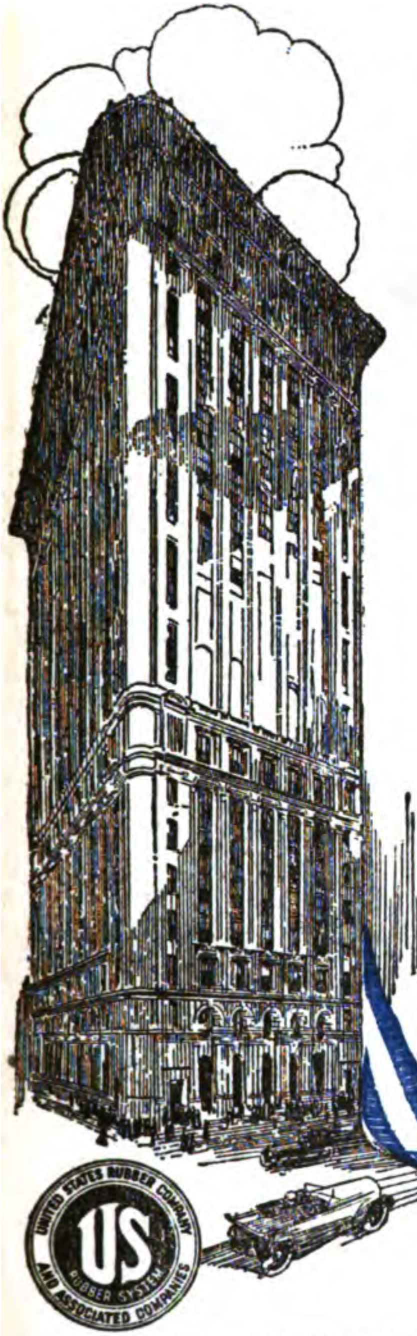
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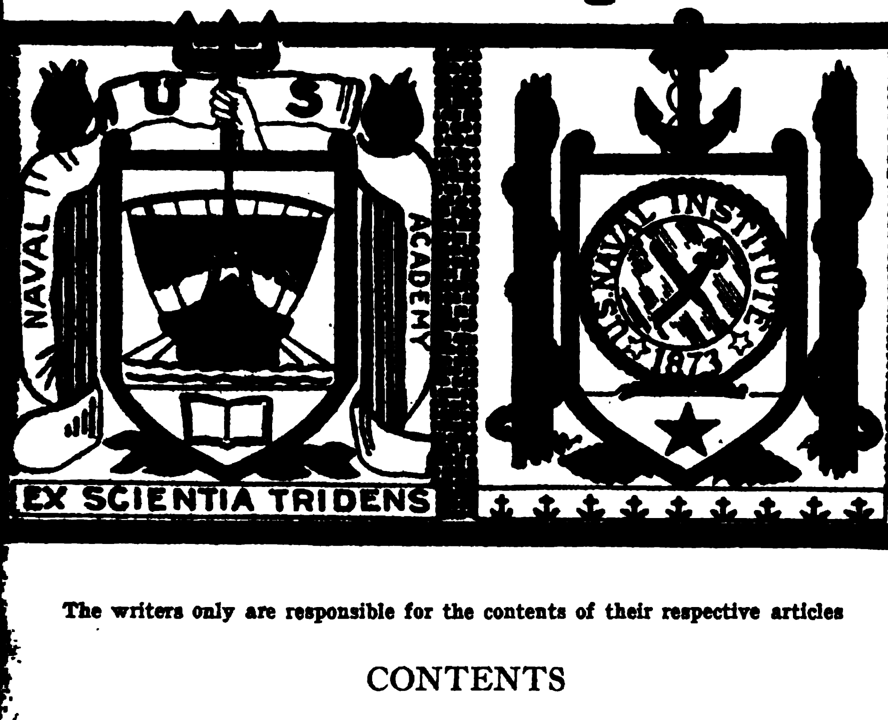

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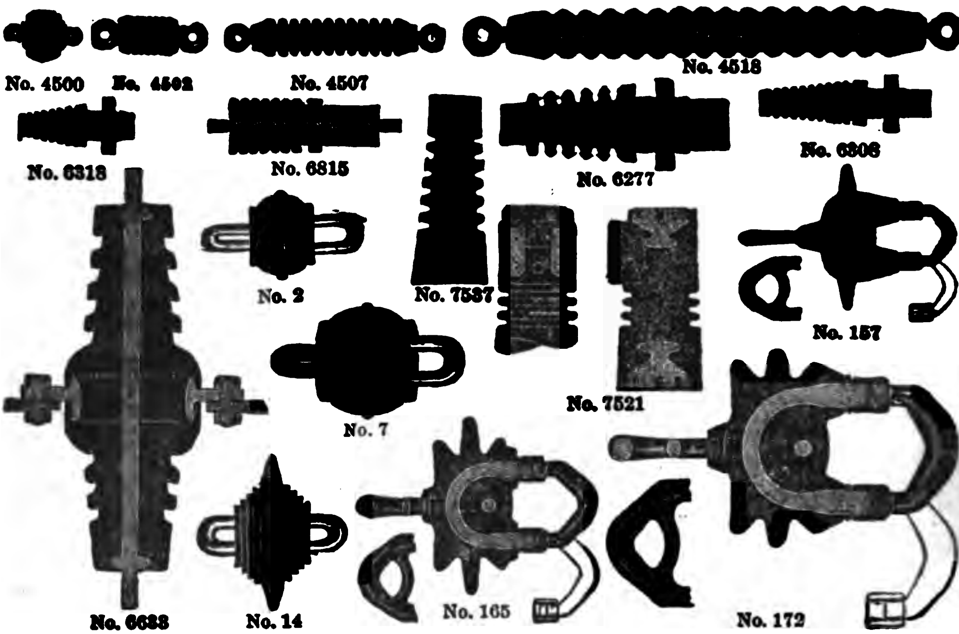

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ACCURACY OF FIRE AT LONG RANGES

By CAPTAIN J. V. CHASE, U. S. Navy

In recent years there has been much discussion on the subject of the accuracy of our naval guns at long ranges, brought about not only by the natural increase in practicable ranges, due to the development of guns of larger caliber and greater velocity, but also to the laudable desire to push the effective battle range to the extreme limit possible.

Undoubtedly greater accuracy of weapons and superior skill of personnel have their most telling effects at long ranges, for at these ranges superior accuracy and skill affect most decidedly the relative number of hits obtained.

Some 17 years ago, I undertook a mathematical investigation to ascertain the value of the advantage accruing to a naval force engaging an adversary numerically equal but so placed that a portion of his force was masked or beyond effective range. The result of this investigation showed that the advantage was measured, not by the ratio of the number of the opposing ships actually engaged, but by the square of this ratio. Here was the first statement of the so-called "*n* square law," a law discovered independently some years later by an English writer.

The application of this law to long range fighting is this: Suppose our greater accuracy of weapons and superior skill makes us feel confident that at a certain long range we can

make 4 hits to our adversary's 3. Then if we engage a numerically equal force at that range our superior hitting ability makes this numerically equal force equivalent to one only $\frac{3}{4}$ as large possessing, ship for ship, a hitting power equal to our own. Therefore, according to the n square law our chances of victory are not as 4 is to 3, but as 16 is to 9. Moreover this law shows that in this case the superior force after annihilating the inferior would have left the equivalent of $\sqrt{\frac{7}{16}}$ of its original force.

The n square law is based upon the material damage inflicted and sustained and does not take into account the moral effect due to the knowledge of the inequality between the damage inflicted and that sustained, a knowledge giving rise to a depression on one side and to a corresponding elation on the other.

Courage and grim determination may serve to minimize this moral effect, but in the inanimate vessels themselves is found no counterbalancing force to offset the physical advantages conferred by superior accuracy of weapons coupled with greater skill of personnel.

The foregoing brief discussion suffices to indicate the importance of attaining the maximum effective battle range. It may be well, here, to determine generally what may logically be called the maximum effective battle range. At short ranges the target presented by an adversary is wholly a vertical one and, in estimating the accuracy of our weapons, we are wholly concerned with vertical and lateral errors. As we increase the range we reach a point where the tangent of the angle of fall is approximately equal to the enemy's freeboard divided by his beam. At this point the target may be regarded either as a vertical or horizontal one. Beyond this point, the target is largely a horizontal one and we are concerned with range and lateral errors only in estimating the accuracy of our weapons. These errors increase as some function of the range, whereas the dimensions of the target remain fixed. It is obvious that with a given accuracy of weapons and skill of personnel a range may be established beyond which the probable number of hits obtainable by the expenditure of a ship's allowance of ammunition is insufficient to inflict serious damage upon an adversary.

The range so determined may be regarded as the extreme effective battle range. The accepted maximum effective battle range should be as little inside this extreme range as our judg-

ment indicates to be reasonable. As we cannot always count upon a full allowance of ammunition being on board we might define the maximum effective battle range as that at which the expenditure of 75 per cent of the ammunition allowance will probably produce a number of hits sufficient to cause serious damage to our adversary.

Nothing has been said, so far, regarding rapidity of fire. The time element, of course, must enter into our calculations, but a rapidity of fire purchased at the sacrifice of accuracy of fire is undoubtedly a disadvantage and not an advantage. If we fight at a maximum effective battle range justified by our superior accuracy of fire, maintaining a rapidity of fire consistent with such superior accuracy, it is obvious that a superior rapidity of fire on the part of our adversary avails him nothing. It simply hastens his useless expenditure of ammunition. We must strive to shorten the time between hits without increasing the number of misses. The longer the time between misses the better; it lessens the waste of ammunition.

It is difficult to foresee what will be the ultimate limit of the maximum effective battle-range as defined in the foregoing paragraphs. Before the development of aircraft there appeared to be a limit established by the limit of vision from the most elevated observation position practicable on the firing ship. The possibility of using aircraft for observation seems to indicate that the ultimate limit of the maximum battle range will be established solely by the ultimate accuracy of the weapons employed.

It behooves us, therefore, to increase this accuracy by every practicable means available.

The problem of hitting a target, stated in its simplest form, is (1) to determine what position the target will occupy at a given instant and (2) to direct our guns in such a manner that their projectiles will fall upon that spot at the given instant.

The two parts are largely independent, but closely coordinated. The first part is essentially the fire control problem, the second part is chiefly a matter of ordnance and gunnery and demands accuracy of weapons and their accessories. It is needless to remark that skill of personnel is demanded in both parts.

In the solution of the fire control problem there must appear some form of tracking. Some perfom this tracking by means of rangefinder distances, and bearings; others measure the dis-

tance by means of the guns themselves for, in reality, that is what we do when we attempt to "spot on." No matter which method or combination or variation of methods we adopt we must have confidence in our "yard stick." Rangefinder and gun alike must give readings on a fixed range differing little from the mean of all the readings taken by the same instrument; in other words, the mean error must be small. The French have a rangefinder mount carrying three rangefinders of the same size and type, and presumably having the same mean error and by an ingenious device utilize a continuous mean of the readings of the three instruments.

If D be the mean error of each instrument the mean error of the mean of their three readings is $D_0 = \frac{D}{\sqrt{3}} = .57735D$. In this way they get the same accuracy that could be obtained from a single instrument having a mean error equal to 57.735 per cent of the mean error of each one of the three instruments actually employed. The same principle can be applied to the gun when it is used as a rangefinder. By firing a 3-gun salvo, instead of a single gun for ranging shots, there would be obtained a mean range corresponding in accuracy to that obtainable by a gun having a mean error 57.735 per cent of that of each gun used, provided we could estimate accurately the position of the mean point of impact of the salvo.

No matter what method be employed we obtain, at certain instants, more or less accurate determinations of the enemy's position and from these positions a more or less accurate estimate of the enemy's course and speed. The more accurate the instruments employed, the more nearly correct will be our determination of the enemy's position, course and speed. It must be borne in mind, however, that however accurate these successive positions of the enemy may be, there will always remain the error due to the uncertainty of the enemy's movements during the interval of time from the last observation before our shots are fired until they land. In order to reduce this possible error to a minimum, we must cut this time interval down to the smallest possible. This means reducing as much as possible the time from the last observation to the firing of our shots and using the highest muzzle velocity practicable, so as to reduce the time of flight as much as possible.

Several articles have been written seeking to demonstrate that the mean errors of the gun should not be below a certain percentage of the fire control error in order to obtain the maximum percentage of hits. The arguments advanced appear reasonable, provided we regard the fire control error as being wholly independent of the gun error. The two errors are, however, closely related and it appears to me that so long as we use the gun in any way to measure the range we must have it as accurate as possible, and the two errors will approach the same value.

Let us consider the simplest case possible—a stationary ship firing at a fixed target whose distance is only approximately known. Suppose two ships fire 4-gun salvos—one with guns having a mean error of 100 yards and the other with guns having a mean error of 200 yards. Now the mean error of a salvo range—that is, the mean variation of the center of impact of a salvo from the true range—is in one case $\frac{100}{\sqrt{4}} = 50$ yards and in the other $\frac{200}{\sqrt{4}} = 100$ yards. This means that the chances are 9 to 1 that the salvo of one ship will not fall more than 100 yards from the point where it was predicted to fall. In the other case, the chances are the same that this distance will not exceed 200 yards.

Suppose in both cases the best estimate of the distance of the target is 18,000 yards and that the first salvo from each ship falls 600 yards short of the target. One ship feels reasonably certain that the true range of the target lies between 18,700 and 18,500. The other ship with the same degree of certainty knows the true range of the target lies between 18,800 and 18,400 yards. Let each ship increase the range 600 yards for the second salvo and let us consider the following cases: (1) the second salvo falls 200 yards short of the target; (2) 100 yards short; (3) at the target; (4) 100 yards over and (5) 200 yards over. Below are tabulated the limits of range as established by first salvo, by second salvo and both salvos:

An examination of the table shows clearly how reduction of the mean error of the gun reduces the fire control error. Moreover, a small mean error means generally well bunched salvos which facilitates the estimation of the distance of the center of impact to the target by observers in aircraft or captive balloons.

Even after the true range has been established and the fire is continued with a constant sight bar range, the centers of impact of salvos, at best, can be confined to an area whose center is the target and whose dimensions are directly proportional to the mean errors of the gun in range and deflection. It is obvious in this case that the salvos, whose centers of impact are confined to the smaller area, will score the greater number of hits.

Where target and firing ship are both moving the problem is more complicated but the same principles apply.

It is believed that the mean errors of rangefinders can be established for various ranges and then the rangefinders be used

Case	1st	2d	Both	1st	2d	Both
..	18,700 18,500	......	......	18,800 18,400	......	......
1	18,700 18,500	18,900 18,700	18,700	18,800 18,400	19,000 18,600	18,800 18,600
2	18,700 18,500	18,800 18,600	18,700 18,600	18,800 18,400	18,900 18,500	18,800 18,500
3	18,700 18,500	18,700 18,500	18,700 18,500	18,800 18,400	18,800 18,400	18,800 18,400
4	18,700 18,500	18,600 18,400	18,600 18,500	18,800 18,400	18,700 18,300	18,700 18,400
5	18,700 18,500	18,500 18,300	18,500	18,800 18,400	18,600 18,200	18,600 18,400

much the same as guns in measuring distances, the average of several simultaneous readings corresponding to a salvo of guns.

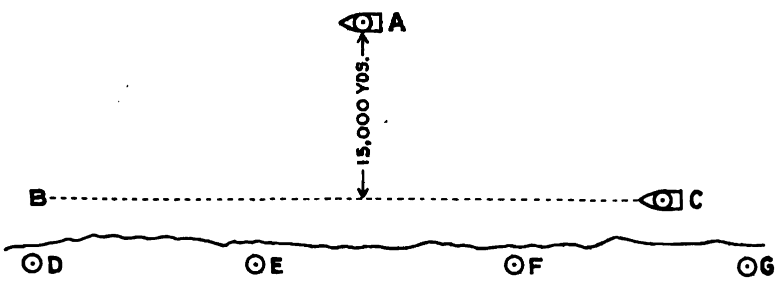
The sketch opposite shows a method of ascertaining the mean errors of rangefinders at various ranges.

It is evident that comparisons of the rangefinder readings with the true distances obtained from the plotting by the shore stations will give the rangefinder errors for the various ranges.

If a suitable place such as a strait can be found, where ships may pass on approximately opposite courses about 15,000 yards apart, and stations can be established on each side of the strait, then two vessels can steam on approximately opposite courses and take simultaneous rangefinder readings on each other. Each vessel's course will be plotted by its own set of stations and a

comparison of the two plottings will give the actual ranges at various times. Some form of trophy might be awarded to the vessel obtaining the most nearly correct set of ranges. In both of these tests, excellent practice in taking long varying ranges under way will be obtained and considerable knowledge of the working accuracy of the rangefinders will be accumulated.

Compared with the gun as a range measuring instrument, the present rangefinder has this disadvantage—its mean error increases at least as the square of the range, whereas that of the gun should increase approximately as the first power of the range. It would, therefore, appear that at some range their mean errors would be numerically equal—within this range the rangefinder



A = ship at anchor, position accurately plotted.
BC=course of ship taking simultaneously ranges on A at intervals.
D, E, F, G=accurately plotted shore station for fixing position of A and positions of ship steaming on course BC.

would be the most accurate range measuring instrument but beyond this range the gun would give the more accurate measurements.

It seems to me that as the maximum effective battle range is increased we must depend more and more upon the accuracy of our guns, not only to hit the enemy after we have established the true range but also to determine the true range. Our elevated observers, especially if we place them in aircraft are in a better position to utilize the range measuring ability of the gun than that of the rangefinder. Looking down upon the range, an observer can align his gun "yard stick" and estimate very accurately the amount it overlaps or falls short of the true range. One may regard the ship as a storehouse of a large number of such "yard sticks," each labelled with its supposed true length

but each varying from its tagged length by an amount not exceeding a known quantity depending upon the mean error of the gun. The observer calls for a certain length "yard stick," lays it down on the range and observes how much too short or too long it appears to be. He immediately knows the true range lies between certain limits, he calls for another "yard stick" and establishes new limits for his true range and by comparison with the first limits established narrows the limits between which the true range must lie. For example, suppose an observer is observing the fire of a ship firing 12-gun salvos, with guns having a mean error of 200 yards at 20,000 yards. The observer knows that if he calls for a 20,000 yard 12-gun salvo "yard stick" that the chances are over 9 to 1 that its true length will lie between 20,120 and 19,880 yards, and that the chances are about 3 to 2 that its true length will lie between 20,060 and 19,940 yards. If, therefore, he applies the "yard stick" he receives from the ship, and finds it 200 yards too short he feels reasonably certain that the true range lies between 20,320 and 20,080 yards and that it is more than probable that its true length lies between 20,260 and 20,140 yards. If he decides to call for a 20,100-yard "yard stick" and finds it 100 yards too long, he feels reasonably certain that the true range lies between 20,120 and 19,880 yards. Combined with the first results, this makes him feel reasonably certain that the true range lies between 20,120 and 20,080 yards. He can, therefore, call the true range 20,100 yards and feel reasonably certain that the range thus established is not more than 20 yards in error.

So far, I have dealt with that part of the problem of hitting a target that has to do with the accurate determination of the position of the target at a given instant, and have shown how important is the accuracy of our guns, regarded merely as rangefinding instruments. There remains that part of the problem which relates to placing our projectiles at the given instant on the position occupied by the target. It is needless to remark that in this part of the problem the accuracy of our guns is *all* important, for it is obvious that accurate determination of the position of the target and rapidity of fire avail us nothing if we be unable to place our projectiles where we desire them to fall.

Now human experience shows that the perfect instrument never has and probably never will be made. Even when we seek to

solve the simplest physical problem, such as ascertaining the true distance between two fixed points, we find that no matter how carefully and accurately made our measuring instruments may be, and no matter how carefully we use it under conditions that appear so far as we can judge, to be identical, we do not obtain identical values.

Experience has taught mankind to make a number of measurements under conditions which appear to be identical and to accept the arithmetical mean of these measurements as being the nearest approximation to the true value attainable with the instruments available. This faith in the arithmetical mean is based upon the assumption that the difference between any particular reading and the true value is made up of the algebraic sum of a number of elemental errors, each one of which is of such a nature that equal positive and negative values are equally probable. It follows that the positive and negative limits of value of the elemental errors must be equal. Therefore, in an infinite number of measurements each elemental error would occur in pairs of equal magnitude but opposite sign. In the arithmetical mean, therefore, all elemental errors would cancel out leaving the arithmetical mean equal to the true value. It is obvious that if there be an elemental error constant in size and sign in each measurement, this error will appear undiminished in the arithmetical mean. Moreover, if there be an elemental error whose positive and negative limits are unequal, the arithmetical mean will contain the mean value of this error no matter how great may be the number of measurements made.

Based upon the accuracy of the arithmetical mean and the nature of the elemental errors, as set forth above, mathematicians have evolved a theory of errors and deduced the "error function" which is a continuous function between the limits of $+\infty$ and $-\infty$ and, therefore, covers all errors between those limits.

Inasmuch as it is unlikely that in any given measurement, all or a great majority of the elemental errors will have the same sign, the conclusion is reached that small errors are more frequent than larger ones.

As has been said, the theory of errors cover all errors between $+\infty$ and $-\infty$ and so tacitly assumes that infinite errors in either direction are possible. Now, as a matter of fact, in practically all physical problems an infinite error in either direction is an

impossibility. This discrepancy between theory and practice, however, is easily reconciled as the probability of having an error greater than a certain moderate size is very small and in general can be neglected. Practically we do not consider the possibility of committing an error greater than 4 times the mean error. According to the theory of errors in every 2000 measurements we should expect to find 3 errors greater than 4 times the mean error.

Mankind has not been satisfied to accept the arithmetical mean as being the best value obtainable, but has sought some means of ascertaining how near the true value this mean really is. In the size of certain defined errors is found the best indication of the accuracy of the results obtained. These defined errors are (1) the probable error, (2) the mean absolute error, and (3) the mean error.

The probable error is that error which is just as likely to be exceeded as not. This error is the one generally adopted by scientists as the criterion of the accuracy of their measurements. The mean absolute error is thus defined—if we find the variation of each measurement from the true value and, considering only the absolute value of these variations (disregarding signs), obtain the mean value of these variations, this is the mean absolute error. For reasons to be explained later, this is the criterion generally adopted for ascertaining the accuracy of fire. Generally, the word "absolute" is omitted, as the *true* "mean error" is seldom employed and is only of academic interest. The *true* mean error is obtained by a process similar to that for obtaining the mean absolute error except that each variation is squared and the square root of the mean of the squared variations gives the value of the mean error.

All these errors may be expressed in terms of a quantity known as the measure of precision. If their values be obtained from an infinite number of measurements, such values are called observational values. If obtained from a finite number of measurements by assuming the arithmetical mean value to be the true value, the values of the errors thus obtained are called apparent values. The errors as defined are in fixed numerical ratio, thus: if unity represent the probable error the mean absolute error is 1.1829 and the mean error is 1.4826.

If D be the true value of any one of these errors, D' be the apparent value of the same error derived from n measurements,

and D_0 be the corresponding error of the arithmetical mean, the following equations are easily deduced:

$$D' = D\sqrt{\frac{n-1}{n}}. \qquad D_0 = \frac{D}{\sqrt{n}} = \frac{D'}{\sqrt{n-1}}$$

For example, suppose the apparent mean error of a gun deduced from 100 shots is 200 yards, then

$$200 = D\sqrt{\frac{99}{100}} = .99499D \text{ or } D = \frac{200}{.99499} = 201 \text{ yards.}$$

$$D_0 = \frac{201}{\sqrt{100}} = \frac{200}{\sqrt{99}} = 20.1 \text{ yards.}$$

This means that the value of the mean error which we derive from 100 shots is within one yard of the value we would obtain from an infinite number of shots. Moreover, the mean error of the center of impact of the 100 shots is 20.1 yards. This means that if we fired an infinite number of groups, of 100 shots each, and measured the absolute variation of the mean point of impact each group of 100 shots from the mean point of impact of all the shots and obtained the mean value of these variations, this mean value would be 20.1 yards. If we take 4 times the mean error to be equal to the extreme error and fire a number of groups of 100 shots each, we would expect all the mean points of impacts of the groups to be confined in a distance equal to $8 \times 20.1 = 160.8$ yards. Similarly all the individual shots should be confined to a distance equal to $8 \times 201 = 1608$ yards.

With the value $D = 201$ yards (derived from 100 shots) let us see what we may expect in 12-gun salvos.

$$D' = 201\sqrt{\frac{11}{12}} = 192.4 \text{ yards.}$$

$$D_0 = \frac{201}{\sqrt{12}} = 58 \text{ yards.}$$

We should, therefore, expect that the spread of a salvo not to exceed $8 \times 192.4 = 1539.5$ yards and the mean points of impact to be confined in a band not exceeding $8 \times 58 = 464$ yards in width.

The foregoing numerical examples illustrate the following points: (a) from the results of firing a comparatively small number of well aimed rounds under conditions as nearly identical as possible a very accurate determination of the true value of the mean error may be made, (b) from the results of such a determination the results to be expected from firing a few rounds from

a single gun or a salvo from a limited number of guns may be predicted, (c) the maximum spread of salvos is directly proportional to the value of the mean error, (d) the mean point of impact of successive salvos of n guns each may be regarded as single impacts made by a more accurate weapon whose mean error is $\frac{1}{\sqrt{n}}$ times the mean error of each gun in the salvo.

Sufficient has been said to indicate the great importance of eliminating or at least reducing to a minimum the elemental accidental errors, thereby reducing the mean error of our guns. Only in this way can we increase the accuracy of the determination of the range by use of the gun and increase our ability to place the mean point of impacts of our salvos at or near the target, thereby increasing the density of impacts over the target area and consequently the probable number of hits. It is useless to theorize about the relation to be maintained between the fire control error and the mean error in order to obtain the maximum number of hits. The fact remains that the fire control error, in the last analysis, must be reduced to the smallest possible and this can only be done effectively by reducing the mean error of the gun to the minimum. When this has been accomplished, if a greater spread of salvo be found to be desirable it can be readily accomplished by deliberately elevating the guns to slightly different angles of elevation without in any way decreasing our ability to place the center of impact at or near the target.

Reference has already been made to constant errors and to errors having unequal positive and negative limits which latter errors may be decomposed into two parts, one part being a constant error equal to the mean value of the error and the other part being an accidental error whose maximum absolute value is equal to one half the difference between limits of the original error.

Of the first type of constant error are those due to maladjustment of sighting devices and those entering into the "Ballistic Correction" and therefore allowed for by that correction. It may be observed, however, that owing to the inaccuracies of the formulæ by which the ballistic correction is computed, a portion of the constant errors remain unallowed for.

Of the second type of constant error are the personal errors of persons engaged in laying the guns. Probably no one's per-

sonal error is constant but varies between limits which in general are unequal in the positive and negative directions. On a moving platform one pointer generally fires too soon, another too late, but neither one by an absolutely fixed amount.

For the above reason salvo firing by pointer fire must generally be inferior to director fire. In the first case the dispersion of a salvo must be increased by the various personal errors of the various pointers. In the second case the dispersion remains unchanged but the salvo as a whole falls too far or too near by an amount equal to the directorscope operator's personal error.

A little experience enables one to estimate and allow for this personal error of the directorscope operator. The same is true of any constant error that exists in all the shots of a salvo.

The process of allowing for such constant errors is much the same as that involved in applying an instrumental index correction to an observed angle.

Where constant errors exist in only a portion of a ship's battery it is very difficult from the results of firing to determine the nature and magnitude of these errors and often their very existence may remain concealed.

For example, suppose a ship having 12 guns mounted in 4 triple-gun turrets fires 3 salvos from each turret singly. There will result 4 groups of 9 shots each. From the fall of shot in each group there may be computed the mean point of impact of each group and the apparent mean error of each shot in the group, and then the true value of the mean error of each shot in a group. There will result 4 values of the mean error of a single shot. If there be no individual errors in the various guns these 4 values will be substantially the same. Suppose D, the real mean error derived from D', the apparent mean error, by the formula $D'=D\sqrt{\frac{8}{9}}$, be equal to 200 yards.

Now the mean error of the centers of impact by turrets will be $D_0=\frac{D}{\sqrt{9}}=\frac{D}{3}$. Treating the four centers of impacts as the fall of four shots the apparent mean error of a single center of impact may be computed and substituted in the formula

$$D'_0=D_0\sqrt{\frac{3}{4}}=\frac{D_0\sqrt{3}}{2}=\frac{D}{2\sqrt{3}}=\frac{D\sqrt{3}}{6}.$$

Now since in computing D'_0 we add the absolute values of the 4 errors and divide by 4, the sum (S) of the errors must be

$$S=4D'_0=\frac{2D}{\sqrt{3}}=D\frac{2\sqrt{3}}{3}=231 \text{ yards.}$$

Therefore, the following errors of the centers of impact by turrets are consistent with the value of $D=200$ yards, and the existence of no turret constant errors.

I	II	III	IV
+75 yards	+40 yards	−40 yards	−75 yards

Suppose now we introduce in turret I a constant error equal to −150 yards and in turret IV a constant error of +150 yards. The errors of the centers of impact become:

I	II	III	IV
−75 yards	+40 yards	−40 yards	+75 yards

It is obvious that such a fall of shot is also consistent with the value $D=200$ yards and gives no indication of the existence of the constant errors existing in turrets I and IV.

If we change the signs of the constant errors in turrets I and IV the fall of shots become:

I	II	III	IV
+225 yards	+40 yards	−40 yards	−225 yards

The existence of errors in I and IV approaching in value the extreme error $4D_0$ would make us suspect the existence of constant errors. Moreover, the apparent value of D'_0, derived directly from this fall of shot, equals 132.5 yards; the value computed from $D=200$ yards, is about 58 yards. Calling D''_0 the apparent value and D'_0 the computed value; we might put $D''^2_0=D'^2_0+C^2$ and compute C which will be found to be about ±118 yards. Applying this to the fall we might make a second computation and find $C'=\pm 46$ yards. Applying this second correction we would over compensate by 14 yards.

Such a procedure, however, cannot be adopted except in special cases where other reasons may indicate such a course.

The case cited is simplified by the symmetry of the fall of shot assumed. When no such symmetry exists the situation becomes more complicated.

Suppose in the case assumed we had introduced into I a constant error of −75 yards and into IV one of +75 yards thus

reducing to o the apparent error of these two turrets. Now the apparent mean error is 20 yards—much less than 58 yards, its computed value. Yet no one would have the temerity to try to increase its apparent value to its computed value and certainly would not meddle with turrets I and IV where the chances are equal that he would apply the correction in the wrong direction.

From the foregoing one might infer that the detection of constant errors from the analysis of the fall of a limited number of shots would be a hopeless task. In general this is more or less true as regards constant errors of the same order of magnitude as the mean error caused by the accidental errors. *This emphasizes the importance of reducing the magnitude of the accidental errors, for it must be apparent that could these accidental errors be wholly eliminated, thus making the mean error, due to their existence, nil, every constant error would be made to appear in its true sense and magnitude.*

Of course the real remedy for errors, constant as well as accidental, lies in the direction of prevention rather than of cure.

Still, much can be done by searching analysis. In the case just cited it is probable that analysis of the individual fall of shot by various combinations of groups would reveal the fact that only the shots from turrets II and III would give entirely consistent results and lead us to infer the existence of constant errors in turrets I and IV. Such analysis might also give us some clue as to their sign and magnitude.

Throughout this discussion I have purposely adopted the mean absolute error as the measure of accuracy of fire. This seems to me to be the only logical measure.

For some time many people have used the size of the so-called "pattern" as the criterion of accuracy of fire and articles have been written with the object of establishing a numerical relation between the size of the "pattern" and the "mean dispersion," dependent upon the number of shots contained in the "pattern." So far as I have been able to determine the term "mean dispersion" is absolutely synonymous with "apparent mean absolute error" as determined from the fall of the number of shots under consideration. The size of the "pattern" is determined by the fall of two shots no matter how many shots may be in the pattern—one shot has the greatest positive error,

the other the greatest negative error of all the shots under consideration.

If there be n shots in a salvo and it is stated that the pattern is d yards in size, the only information really given is that the distance between the two extreme shots is d yards. This means nothing more than that the algebraic difference of the largest apparent positive error and the largest apparent negative error is d yards. We gain no information as to the fall of the remaining (n-2) shots.

If 10 salvos of 10 shots each have been fired and from the fall of shot the apparent mean error has been computed and we are told that its value is 100 yards, we can immediately calculate that the real mean error is very approximately equal to 100.5 yards and we could make a sketch showing very closely how the shots must have fallen and where the mean points of impact of the various salvos were located.

If, concerning the same firing, we are told that the mean pattern is 500 yards we gain only incomplete knowledge regarding 20 shots—of the remaining 80 we can only infer that in each of the 10 salvos 8 shots were bunched in a space less than 500 yards wide.

Every one knows that a large error of a certain type of gun means a large pattern when salvos are fired by a number of such guns, but a large salvo pattern does not necessarily mean a large mean error. A mean error so small as to be practically negligible combined with a large individual constant error varying from gun to gun in magnitude and sign will give a consistently large pattern. Moreover, the pattern size will give no indication of the existence of these constant errors and might lead to the erroneous assumption of the existence of a large mean error and consequently large elemental accidental errors.

Consideration of pattern size, only, undoubtedly may force upon us the conclusion that we have a white elephant on our hands; it can never indicate the way to rid ourselves of the undesirable animal.

If in the 10 salvos just considered we have means of identifying the shots from each of the 10 guns then we may group the shots by guns and compute the mean error by guns.

If the 10 values thus obtained are substantially the same we may rightly infer that all the guns have the same mean error

and consequently have no appreciable *individual* accidental errors. Now if we compute the mean error by salvos we will get 10 other values. These may or may not be substantially the same. In either case if these values are not consistent with the values obtained by individual gun groups, we may rightly conclude that some or all the guns have constant errors. An inspection of the two groupings followed by a trial and error process will probably indicate the size and magnitude of these constant errors whose elimination will bring the various values of the mean error into agreement. The foregoing reasoning presupposes that all salvos are fired under as nearly identical conditions as possible, such variations as may unavoidably exist should be allowed for by the best available means of correction.

If a successful means of identifying the various shots can be developed, the foregoing method of firing as many all-gun salvos as there are guns in a salvo will constitute the simplest and best method of calibrating a ship's battery.

It has the advantage over methods involving the firing of the guns singly in that all shots are fired under practically battle conditions so far as the actual firing of the guns is concerned.

I have dwelt at some length upon the importance of ascertaining the mean error of our guns at long ranges and then taking such steps as may be necessary to reduce these mean errors to a minimum. Only in this way can we hope to increase the accuracy of our guns to the extent necessary to insure victory in a long range battle.

As has been pointed out, the mean error is simply the algebraic sum of a number of elemental accidental errors. In the rare case in which all these elemental errors have a maximum size and the same sign we have an extreme error which experience shows to be equal to 4 times the mean error. Now, if we can enumerate all these elemental errors and estimate the maximum value of each, it is evident that we may by addition obtain synthetically a value of the extreme error. In general, if we compare such synthetic values with those derived from observational values of the mean error we find the observational value much greater than the synthetic value. We are, therefore, forced to the conclusion that either we have underestimated the size of the elemental errors enumerated or, more likely, have failed to include

in our list of elemental errors one or more whose existence we probably have not even suspected.

So far as the gun and its mount is concerned, they may be considered as having performed their full duty if they deliver the projectile at the muzzle of the gun at predetermined angles of elevation and train and endowed with predetermined translational and rotational velocities.

Recent accurate observations indicate that the angles of elevation and train remain unchanged until after the projectile has left the gun. Such errors, therefore, that arise from variations in these angles must be due to errors in setting.

Proving ground records of velocity firing do not indicate serious variations in muzzle velocities with the same weight and index of charge but persistent effort is being made to reduce existing variations. Recent large caliber experimental firings seem to have brought to light the possibility of large variations in muzzle velocity by the location of the charge in cases where the total length of charge is materially less than the distance between mushroom face and projectile base. When all sections of the charge were placed together at the ignition end of the chamber 3 per cent more than service velocity and 18 per cent more than service pressure were obtained, whereas normal velocity and pressure were obtained when one section was placed at the ignition end of the chamber and the remaining sections were placed at the other end. That such variations may obtain in service seems to be indicated by the result of recent carefully conducted experimental firing of the main battery of one of the capital ships. The firing was at a fixed angle of elevation and included both single gun firing and firing of various groups in salvo including all-gun salvos. Great care was taken to make all loading conditions the same. The range was about 18,000 yards. In every case, without exception, the range of the mean point of impact of each group was, *very uniformly* about 1000 yards greater than the best predicted range that could be made allowing for every known ballistic variation. An increase of 3 per cent over service velocity would account for 700 of the 1000 yards increase found by observation.

Up to the present, little attempt has been made to measure the rotational velocity actually attained by the projectile. In the near future, it is hoped to obtain accurate data upon the rotational

velocity actually attained and also data upon the reduction of rotational velocity that takes place along the trajectory.

After the projectile leaves the muzzle any additional errors that may be introduced is a matter of exterior ballistics and much depends upon efficient projectile design to insure stability and accuracy of flight.

Undoubtedly, the most critical portion of the trajectory is that part where the projectile is still influenced by the powder gases emerging from the muzzle. These rapidly expanding gases are in turbulent motion and rapidly attain a very high velocity, exerting upon the projectile sufficient force to accelerate it for a considerable distance beyond the muzzle of the gun. It seems to me to be highly improbable that the center of pressure for these gases will lie in the longitudinal axis of the projectile. If the center of pressure be eccentric, a couple of considerable magnitude may be brought into play creating a tendency to angular deviation that must be counteracted by the stability of the projectile. It is obvious that an angular variation at the origin of the trajectory produces an increasing lineal error as the range is increased. It is, therefore, highly important to reduce such angular deviation to a minimum.

A possible way of reducing the suddenness of change of conditions as the projectile emerges from the muzzle is to remove a number of the lands for some distance from the muzzle retaining a sufficient number of lands to maintain the longitudinal axis of the projectile coincident with the axis of the bore so long as the projectile is within the gun. This procedure is along the lines which, it is understood, were adopted by the Germans in their long-range gun. It is understood that they left a considerable length of the bore at the muzzle unrifled. Their projectile, being rifled on its cylindrical surface, there was no need to retain any lands in the bore for centering purposes.

The problem of satisfactory projectile design is a complicated one, the solution of which, in my opinion, will necessitate a considerable amount of experimentation. For armor piercing ability, the projectile proper must have a stout blunt point but for ranging qualities the outward form must have a long slender point. This necessitates fixing a long pointed wind shield over the blunt pointed projectile.

In the determination of the stability of flight, the location of the center of gravity, the point where the line of action of the resistance intersects the longitudinal axis, the moments of inertia about the longitudinal axis and about a transverse axis through the center of gravity and the rotational velocity about the longitudinal axis must be considered. The interrelation of these factors is probably very complex and experimental data bearing upon this interrelation is very meagre. Consequently we are confronted at times with results that are difficult to explain. In some recent 6"/53 firing, standard projectiles at 3000 f. s. velocity gave evidence of considerably more accurate flight in a gun rifled 1 in 50 turns than in a gun rifled 1 in 25 turns, in which gun, however, the accuracy was markedly better than in a gun rifled 1 in 37.5 turns. On the other hand, in the 4"/50 with standard projectiles, similar in form to the 6" standard projectiles, steady flight could not be obtained in a gun rifled 1 in 50 turns when fired at 2900 f. s. velocity but in a gun rifled 1 in 25 turns normal flight was obtained.

These results are difficult to reconcile. The rotational velocity of the projectile fired at 2900 f. s. velocity in the 4" gun rifled 1 in 50 turns is the same as that which would have been obtained at 3000 f. s. velocity in a 6" gun rifled 1 in 34.5 turns. It may be more than a mere coincidence that the rifling of the least accurate 6" gun was not far from this value.

On the other hand, although the shells wobbled considerably in the 1 in 50 4-inch gun, resulting in a mean range considerably smaller than that obtained in the 1 in 25 4-inch gun, the mean dispersion of the low pitched rifled gun was fully as good if not better than that obtained in the gun with the higher pitched rifling.

One may wonder why I have rather harped upon the subject of the mean error and have stated and restated facts that should be obvious to every one.

I have been impelled to adopt such a course because I have observed a too general tendency to adopt an illogical measure of accuracy—a measure that has filled our literature with wailings about the shortcomings of our weapons; spent our energies in more or less futile efforts and has advanced us but little toward the solution of our difficulties.

I remember reading, during the progress of the late war, a lengthy dissertation upon dispersion emanating from a large group of officers, in which was given at length and in detail a list of possible causes of the dispersion of our guns.

These possible causes, if I remember correctly, were as numerous as are the products of the Heinz factories, and so far as I could make out most of these possible causes and all of those popular food products were about equally closely connected with the subject of dispersion.

In my opinion, the first step towards accuracy of fire at long ranges is the determination of the mean errors at these ranges. The second step is to study and analyze these errors with a view to decomposing them into their elemental parts. Lastly comes the elimination or reduction of these elemental errors and the determination of their residual values.

These steps may and probably will proceed concurrently; all involve much time and labor but our achievements in the last step must be the measure of the success of our efforts.

The elimination or reduction of elemental errors, so far as I can foresee, means, for the gun and mount, the greatest accuracy and uniformity of workmanship with minimum tolerances. It means for the foundations an accuracy and rigidity permitting minimum distortions permanent or temporary.

It means for the powder, a purity of materials and accuracy of manufacture, insuring uniformity of finished product so that when made up in charges of fixed weight and length to insure uniform loading conditions it will give uniform results.

Lastly, it means for the projectile a form and disposition of metal that will insure accurate flight throughout its maximum trajectory.

Only by proceeding along these lines we can achieve at long ranges an accuracy of fire to which we can, as politicians say, "point with pride" and in which we can have a confidence, amounting to assurance, of victory in long-range battle.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TACT IN RELATION TO DISCIPLINE

By Lieut. Commander J. Ogden Hoffman, U. S. Navy

To achieve the greatest results from any organization, civil or military, there must be discipline, tactfully exercised. If the civilian employee refuses to abide by the laws ordained by his employers, he can leave his job or enlist the forces controlled by his labor union, which may or may not support his claim.

In the navy, however, an organization in which everyone, from the highest to the lowest, is serving the same master, the United States of America, there can be no question of refusing to follow the code of written and unwritten laws. These are condensed in the Articles for the Government of the Navy, amplified by the Revised Statutes and personified by the wearers of the naval uniform.

The law, in black and white, is sufficiently detailed to leave few loopholes in the armor of discipline surrounding the service. It remains only, therefore, for the living exponents of the law to so interpret it as to obtain the maximum results.

It is also well for the navy to review its conduct with civilian organizations and individuals and to modify its viewpoint accordingly. It is almost as important to be able to obtain results from someone else's organization as from one's own, and the prestige of the navy depends largely upon the favor with which it is viewed from other circles—in other words, upon its popularity at home and abroad.

A consideration of the importance of tact in its relation to discipline should include all ranks and stations and their conduct, one toward the other. It would be wellnigh impossible to catalogue the different phases of such an elusive quantity, and absurd to prescribe the amount to be used to fit any particular case. The

best we can do is to follow the examples of great men, profit by the mistakes of others, and develop our own personalities along the lines that have been proved to be the most successful.

To anyone who has controlled numbers of men, or who assumes, for the first time, responsibility over others, it is instantly apparent that the proposition differs, somewhat, from anything he has ever done. No two situations are exactly alike, no two men will do things exactly the same way, but they will all produce results if skilfully approached.

Everyone has the privilege of changing his own mind, and the best approach to a new position is to come to it with a perfectly open mind. If the machine is in operation it is wise to quietly sit back and watch it run until the flaws come to light, as they surely will. If the machinery is to be started, organization plays its part and we enter into the discussion of an entirely different subject. We will suppose, therefore, that the plant is running in accordance with the ideas of our predecessor. By "plant" we mean the organization with which we are dealing, be it ship, machine shop, turret or deck division.

The previous incumbent undoubtedly had good ideas, and we should assume, for the present, that everything is running smoothly. In the meantime, we familiarize ourself with every inch of the ground we control, beginning with the matériel, and extending the investigation to the personnel, individually and collectively.

As soon as a new officer steps aboard ship or shore the process of "sizing him up" commences, and it should be mutual, on his part. It will not be long before he has the opportunity of displaying his tact, or the lack of it, and if the first impression that he makes is unfavorable, he will have a hard time to live it down. At the outset he should enlist the services of his seconds in command, obtain their assistance and co-operation. There must not exist the slightest doubt as to who is in charge, but, at the same time, all responsible parties must feel that their voices are heard and their opinions appreciated. If this policy is the opposite to that practised by one's predecessor the situation, at the start, is rather difficult, but will improve with time and the exercise of diplomacy. It recalls an occasion where the engineer officer, finding a certain piece of machinery in deplorable condition, and asking why it had never received attention, was told that the previ-

ous chief got very angry if anyone discovered such a condition before himself. As he had not discovered the defects in question, nothing had been said about it, although his subordinates were thoroughly familiar with the true state of affairs. Such an attitude, on their part, may be a good illustration of "loyalty," but it was rather hard on the inanimate machinery.

One of our foremost organizers used directly opposite methods and, in view of his pre-eminence, they may be considered as standard. A conference having been called to discuss subjects of which all had been forewarned, the topics were taken up, one at a time, and individual views solicited. Having heard what everyone had to say, the master mind came to a decision, which was recognized to be final. Before coming to this decision, advantage had been derived from all the individual opinions and the resultant gained something from each one. We may, therefore, adopt it as an axiom that no two people view a thing in exactly the same way and, even if we consider their opinions of absolutely no value, they will, at least, show us how "not to do it" and eliminate some course that we might have unconsciously considered.

There are many degrees of perfection in the manner in which an order may be obeyed, but unless it is obeyed cheerfully the maximum attainment has not been reached. Much of the grumbling can be eliminated from the execution of disagreeable orders by the exercise of a little tact and by a careful study of the person who is going to carry out the order. On almost every ship there are to be found samples of that peculiar temperament that may perform its duty faultlessly and yet never cheerfully. It is hard to pick flaws in the man's obedience, sobriety, appearance or bearing, and, yet, he always gives you the impression that you have inflicted a personal injury every time you give him an order. Although such an attitude may not impair the efficiency of the work he individually performs, it will undoubtedly have a bad effect on the men who are working with him and there is grave danger of increasing the number of grumblers.

Here we have a situation that is a real problem and which may be solved by a variety of methods. We must, if we can, change the man's state of mind, make him cheerful, improve his influence over his subordinates and associates and, above all, stimulate his loyalty and desire to carry out our wishes. We must not make

him think that we are helpless without his assistance, that he is the only man on the ship capable of filling his particular job, make him a worse grumbler and, in particular, we must not decide that his case is hopeless until we have exhausted every means of approach. Many a good man has been lost to the Service simply because he was not understood, and to understand him is our particular mission, in this case.

This is the situation that confronts us and it must be approached very guardedly and stealthily. Nearly all men can be made to talk and they often reveal conditions that have not been taken into consideration at all. Get them at a time when they are actually doing some work that interests them and discuss the fine points of it with them, like two experts coming to a momentous decision. Having started in this fashion, it is easy to lead the conversation through various channels, until it often ends at the solution for that particular man's "grouch." He probably has been timid about freely expressing himself before, or has suffered in stoical silence, as many of them do. He may be in very real trouble and it is certainly the officer's duty and privilege to give all the consolation the case demands. The enlisted man is often pathetically alone with his personal trouble, although surrounded by a thousand shipmates, and when he feels that someone really cares enough about him to share his burden, life immediately takes on a brighter aspect and efficiency steadily increases. To any of us who have bothered to seriously consider the cultivation of tact and the solution of the personal equation, many concrete examples present themselves.

A man joined the ship in the rating of first-class fireman. In the fire rooms he was worse than useless—all he did was to get in people's way. Although of good physique, he could not throw enough coal to keep up steam in the auxiliary boilers. As a striker in the engine room, he was languid to such a degree that all watches were unanimous in requesting his removal. Finally, he was placed in the machine shop, it being assumed that he could, at least, sort brass turnings from steel and sweep up the shop. The time came to transfer the quarterly War Quota and his name headed the list. On the very day of making out the list a job came up in the shop that puzzled everyone. Strolling up to the machine, this candidate for transfer proceeded to turn out such a perfect sample of accurate work as to make everyone aghast.

He was tried on all the tools in the shop, and there was absolutely nothing he could not do. He could almost make a lathe talk. Regarding his capacity for work, he simply devoured it. Day and night were all the same, he was tireless. It appeared that he had not only served a full five-year apprenticeship in a machine shop, but had completed a night course in a technical college. When asked why, in the name of all that was sensible, he had concealed this ability, he replied, with a slow drawl, that a friend of his had enrolled as a machinist's mate and ended as a third-class fireman, whereas he preferred to go the other way. Luck was certainly on his side, but it also took considerable patience to keep from throwing him into the discard.

One chief boatswain's mate, who carried a very grumbling exterior, also had the ability to do almost anything in a nautical line, but considered small jobs entirely beneath his notice. That is, regarding things like mooring ship, carrying out an anchor or rigging a heavy purchase, he was in his element, whereas the mere evolution of setting up on life-lines or chipping and red-leading the bitts and waterways was too trivial to receive his august attention. The best way to penetrate his armor was to laugh at him. Give him the order, hear all his different reasons why the thing should not be done, then make fun of him and of his aversion to details. Then go on deck, and in a little while you would see a gang of men working like mad to carry out the order, with the chief boatswain's mate driving them like stevedores.

If there happen to be several chronic kickers, a good solution is to put them all in the same part of the ship, within working distance of each other. After hearing each other's songs for a while, the harmony begins to pall and they decide to sing a more pleasant tune. This system worked very well with a pugnacious boilermaker, a humorous coppersmith and a temperamental blacksmith. Each one thought the navy should be run on different lines and refused to help the others except by the constant issue of orders by the engineer officer. The ship was small, the work was arduous and life simply was not worth living with these three, masters of their respective trades, and each one too conceited to take assistance from the others. After placing them in a small, common workshop, a few months brought about a remarkable change. They became like blood brothers, and would meet all comers, in fistic or other combat. Much wielding of heavy sledges

made them dangerous opponents and a little common sense produced a formidable team.

It may be taken for granted that every offender against the naval law commits his breach of discipline with his eyes open and with a fair conception of the result, if his offence is discovered. Unless he enters the service with the avowed intention of starting a career of lawlessness, as soon as he dons the uniform he will have the opportunity of personally witnessing the results of indiscretion and insubordination.

The manner in which these cases are handled will make a great impression on the new man and is bound to affect his future conduct. Men who are punished invariably talk about it afterwards, often with an air of bravado, like the small boy who has been spanked and then walks around, giving the impression that neither his feelings nor anything else has been hurt.

The reduction of the number of offenders to a minimum and the assignment of punishment, when it becomes absolutely necessary, are two of the hardest things that an officer has to do, and ones requiring all of his tact. All of us abhor the discipline that is evidenced by a large daily report list and we dislike the feeling that all sorts of offences are being committed and condoned, or entirely ignored. The latter state of affairs is much the worse of the two, as it indicates a deplorable absence of discipline, as against discipline misguided and carried to extremes. What we should accomplish is, therefore, a reduction of reports to a minimum together with the creation of an atmosphere that leads our subordinates to believe that offences will never be overlooked and that disciplinary action, of some form or other, will always be taken. We might go even farther and establish in the minds of our men the will to do right, not because the opposite conduct is sure to bring punishment, but because the right way to do a thing is always the shortest and best, in the long run. Unfortunately, this state of mind is found in only a comparatively small percentage of the men with whom we have to deal. Some men are instinctively truthful, honest, and are born with the qualities that merit a consistently perfect mark in sobriety and obedience. These men are, however, the exception and still rarer is the man who possesses them and is, at the same time, a skilled and efficient worker.

The first disciplinary dealing with any man, having probably a greater effect on his morale than any subsequent action, should be handled with the greatest care. As a general rule, except for serious offenses, any man deserves another chance before a black mark is entered on his record. The man may even have a bad record from another ship or station and yet a good, heart-to-heart talk will often be just as effective as the most rigorous action. The talk should, if possible, be conducted in private; the language should be simple and forceful, and an appeal made to the man's sportmanship and sense of fairness. Is he going to show that he deserved a square deal or is he going to repay good money with bad, and shatter another illusion of faith placed in human nature? From the majority of cases, it is believed that he will respect the confidence placed in him. If he truly appreciates what has been done for him, his influence will be far-reaching, extending throughout his part of the ship. If the offence is repeated, there must be discipline and let it be swift and sure.

A careful and accurate record should be kept of each man's performance, entirely separate from the meager information that can be entered on his enlistment record. It does not take very long to prepare a card index containing, on each man's card, a current history of all minor offences, special requests, furlough, with the address to which he has gone, and many small notations that form a biography of that man's life on board ship. These details are often most illuminating, and will be forgotten unless recorded when they occur. Men have been kept from getting into trouble by a warning given after consulting just such notes, and, if the system serves no other purpose, it segregates the trouble breeders, agitators and derelicts invariably present among a large body of men.

Too much emphasis cannot be laid on the care with which petty officers should be selected. Once they are rated, they should have the absolute support of the officers. A good and experienced petty officer will, by his own tact and qualities of leadership, deal with slackers and their minor offences and, thereby, lessen the officer's burden. An inexperienced petty officer will have the tendency to report men for minor offences without investigating the cause preceding the effect. If a man is fit to be a petty officer, his orders must be obeyed by those under him and, whether or not he is of long service and experience, any disobedience of his orders must

be considered in exactly the same light as though they had been issued by his superior officer. There is nothing so disheartening to a petty officer who conscientiously reports some infraction of discipline as to have the case dismissed, or a mild warning administered. Such action not only reduces the efficiency of the petty officer, but gives the culprit the impression that toward that particular superior he has nothing to fear, as his exercise of discipline did not receive official sanction.

Gang-spirit exists on board ship, just as it does in any city or town. The men who get into extensive trouble almost always stick together, with the exception of a few isolated cases, as do the men with conspicuously clear records. It is not desired to give the impression that there must be a division between the sheep and the goats, but that an understanding, on the part of the officer, of the divisions among his men will give him an idea of the inner workings of the crew.

Never give an order, unless care is taken to see that it is carried out. Circumstances change so rapidly that, as a rule, it is best to reduce the number of written orders to a minimum. It is very easy for orders to get out of date or to outlive their usefulness and it is naturally most confusing for a new man to consult the crew's bulletin board and final orders several years old, together with more recent editions that may be directly contradictory to the original. It is remarkable how one will find old orders, still kept in the current files, manifestly out of date, and useful only as a cause for perplexity.

In the issue of orders, the greatest tact is required to keep from depriving one's subordinates from all opportunity of exercising their initiative and, at the same time, to have the order carried out as one desires. It deprives subordinates of their sense of responsibility to have them think that the head of the department is never satisfied, unless he has a hand in every minor operation. For this reason, it is thought best to leave details entirely to them. Everything should receive careful supervision and no job is too small to deserve the inspection and appreciation of the man at the top, but he must be very careful that he does not go over the head of one of his subordinates, and sow the seeds of discord. If the work does not suit him, the officer or petty officer in charge is the man to be interviewed, but never the man who is carrying out the latter's orders. This interview should take the form of a dis-

cussion of the relative merits of various ways of doing the work and should not be in the nature of a reprimand, unless an order from superior authority has been disobeyed. If there are several ways of doing the work in question, let the subordinate carry out his own ideas. They may not exactly coincide with one's own views, but the result may be satisfactorily accomplished, just the same. The man's initiative will receive a decided check if every idea of his own is discouraged. When the job is completed he should be told how he could have saved time and labor, if such an improvement is possible, and the next time he has the same thing to do he will be wiser and more efficient.

In discussing the general subject of the tactful handling of men, too much stress canot be laid on the importance of learning to call each one by name. This should be one of the subjects to which a newly arrived officer devotes himself, and he should not be satisfied until he knows and remembers the name of every man with whom he has to deal. It is astonishing how much more snap and alacrity will be put into the execution of an order, if a man is addressed by his own name, instead of being classed under the general category of "you." When the number of men reaches up into the hundreds, it is certainly difficult to catalogue them all, but the subject should be diligently pursued, starting at the top and working down, until they have all been mastered. The fireman leaning on his slice-bar or the seaman on his squeegee-handle (two characteristic attitudes) will forget his day dreams very quickly by hearing his name called by someone to whom he thought he was, more or less, incognito. His first attitude is usually one of surprise, followed by the impression that he must be pretty good, after all, to have been noticed. As soon as a man begins to feel that he is not merely a cog in a big machine, but a living personality, whose existence really affects the big scheme of things, he begins to try a little harder to justify the belief. The making of many a petty officer dates from that moment.

All of us have felt the thrill of pleasure that comes from being addressed by name by someone whose notice we thought we had entirely escaped. With some officers it has become the habit of a lifetime, and many captains know the name of every man in their crew. Men who have seen naval service are found holding positions of trust all over the country, and it is surprising how one meets old shipmates in most unexpected circumstances. The man

is much the more likely to remember his officers' names, as we are all more observant of our superiors than of our juniors, but when the recognition is mutual we can make a real entry on the credit side of our memory ledger.

It is hard to say whether more tact is required in dealing with officers than with enlisted men, but it may be admitted that the effect, in the majority of cases, will be more quickly perceptible with the men and more lasting with the officers. Here, again, we cross the paths of psychology, human nature and the personal equation. Every man, commissioned or enlisted, is a distinct human problem and the more highly strung and nervous the temperament the more the required tact. A high-spirited horse is put in a perfect frenzy by a single touch of the spur, while the steady plodder may be only slightly accelerated by consistent and steady driving, although the effect will accumulate very gradually.

The only way to determine the particular kind of goad that will do the most good is to study all the details of the nature that confronts us. Some people will take the slightest hint, while with others the point of the argument must be as broad as their hand before they can see it and have it penetrate to the inner consciousness. Resentment instantly flares up in some natures, while others will stand any amount of chaff without harboring the least malice. Some people seem to be absolutely devoid of a sense of humor, while others will see the comic side of almost any situation and laugh away the most serious difficulty by sheer good nature.

The golden rule always works both ways. In other words, we must be tactful with our superiors and peers, just as we are with our juniors. A very wise captain once gave one of his officers the following advice: "If the captain reproves you for something you have not done, or your superior officer finds fault with something that you know is absolutely right, just stand and take it, and keep quiet unless your opinion is asked. In either case, if you were right, the other will soon find it out, and his opinion of you will rise, as he then knows that you knew he was wrong and did not tell him so." On another occasion the captain, upon going ashore, left orders for a boat to meet him at a certain landing at a certain time. The officer-of-the-deck despatched the boat, but the coxswain, who happened to be a relief and not the regular man for the boat, went to the wrong landing. The officer-of-the-deck became worried at the non-return of the captain and

called away another boat. It was at night, the crew had to be turned out, the engine was cold and took long to start, and when the second boat got to the landing the captain had been kept waiting nearly an hour. The officer-of-the-deck reviewed in his mind all the possible punishments that might be his due, ranging from a severe reprimand to a court-martial. When the captain came on board all he said was, " Nice dock they have over here," and went below. The junior officer will probably never forget the occasion to his dying day, and it is quite certain that the interests of discipline were satisfied.

When we deal with people from other walks of life and of different customs from our own, we must do as they do, if we wish to realize our own aims. This applies to our dealings with civilian employees and, to a still greater measure, to our conduct with foreigners. In either case, their methods will not be ours, and the best policy is to let them go ahead in their own way, even though it grates on our nerves and strains our patience to the breaking point. The point to remember is that *we* wish to accomplish something, and we cannot do it without *their* help. To anyone who has wasted time trying to conduct business, along American lines, over a foreign telephone, no further illustration will be necessary.

To condense all that we think about, or have said, concerning " tact," resolves itself into an elaboration of the golden rule, with the mental note that, although few people are born with a hundred per cent, we can all study to reach a passing mark. Try to see a thing through the other fellow's eyes, and then combine that with the best possible way of achieving your own ends. You deserve a *perfect* mark when you make him do something just as you wish it, and have him think, all along, that he is doing it exactly his own way.

In naval circles a *cheerful* " Aye, aye, sir," is the acme of good tact, good discipline and good technique.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SKETCH OF PRESENT RADIO SITUATION INFLUENCE ON TACTICS AND STRATEGY[1]

By Lieut. Commander S. C. Hooper, U. S. Navy

The two largest radio concerns in the world are the British Marconi Company, of England, and the United States Naval Radio Service. The British Marconi Company is one of the most important commercial institutions backed by the British Government, and its lines of communication extend over Europe, India, Africa and Canada, with connections to the American Marconi Company in the United States. The United States Naval Radio Service comprises high-power radio stations on both coasts of the United States, in Panama, the Caribbean, Hawaii, Guam, the Philippines, Alaska, Peking, Vladivostok; in addition, all coastal radio stations in the United States, for communication between ships and the Coast, with four exceptions, are owned and operated by the United States Navy. There are about 120 of these stations. Each air station, there are about a dozen in all, is equipped with a naval radio station for the purpose of communicating with airplanes and dirigibles on patrol, for distances of several hundred miles from shore. The navy is developing in addition, a system of navigational radio stations (see appended list) on both the Atlantic and Pacific coasts for the purpose of assisting ships at sea in determining their positions. These latter are especially useful for vessels approaching the coast in thick weather. There are about 50 navigational radio compass stations completed. All naval vessels and all vessels of the United States Shipping Board are equipped with naval radio apparatus, operated by naval radio-men[2]; also vessels of other branches of the government, including the coast guard, light vessels of the Department of Commerce, and the army. The army maintains and operates its

[1] This paper was submitted November 1, 1918.
[2] Naval radio operators removed July 1, 1919.

own radio apparatus except for transports. There were nearly 5000 United States naval radio operators on watch on the ships of the seven seas on January 1, 1919, and a large personnel is required on shore to maintain and install the equipment. Prior to the entering of the United States into the war there were but about 500 operators in the service, with but some 50 radio stations. There were, at the signing of the Armistice, over 5000 men in the service and about 150 stations. The number of shipboard and airplane sets in service has increased from about 400 to about 4000. In addition, a large number of listening-in section base stations were established during the war, but these were of a temporary nature and have since been abandoned. Also the radio service equipped about 15 air stations abroad with naval radio apparatus.

One of the largest problems assigned to the naval radio service at the beginning of war was the development of a transatlantic radio system capable of replacing the cables. Early in the war some of the cables became disabled, being cut by German submarines and otherwise, and it became impossible to repair them due to the torpedoing of cable ships by submarines. It was feared that the entire cable service might at any time become disabled due to submarines. At that time it was only possible to rely on radio communication across the ocean during certain times of the day when static and absorption of signals was a minimum and only about 30 per cent of the time during the summer months. Within one year various improvements were made and new stations constructed, and old stations equipped with new apparatus to the extent that to-day we are able to handle about one-third of the cable business by radio. During the past summer the total reception of signals, both ways, averaged 98.5 per cent as compared with 30 per cent the previous summer.

One of the principal means of increasing the traffic has been the introduction of automatic high speed transmitting and receiving apparatus. Certain stations are now being operated automatically at speeds of from 50 to 100 words per minute as compared with an average of less than 20 words per minute when using hand sending. All reception from Europe, from the high power stations in Lyons, Rome, Nauen, Carnarvon (Wales) and Nantes (France), is done at Otter Cliffs, near Bar Harbor, Maine, and direct wires to Washington are used to communicate the messages to Washington. The transmitting keys at the high

power stations in the United States are operated automatically by means of distant control lines from the keys located in the Navy Department, Washington. For example, the key in the Annapolis Station is pressed by the operator in Washington. During the war two additional receiving stations were maintained at Belmar, N. J., and Washington, respectively, for receiving signals from Europe. These stations were considered as stand-by stations and only supplied the parts of the messages which Bar Harbor failed to copy. The two greatest obstacles to reliable trans-oceanic communication were static and destruction of aerials by winter ice and winds. The static was overcome by using combinations of underground receiving aerials and balanced loops. The difficulty due to breaking of aerial wires by ice forming on the wires was overcome by heating the aerial wires by means of direct current supplied from the main generating machines at the radio stations.

The high power apparatus used is generally the arc and the Alexanderson alternator. Both are quite efficient. The alternator is slightly superior to the arc.

Following the surrender of the German Navy our experts have had an interesting opportunity to compare our own radio apparatus with that of the Germans. It had always been the opinion, among the officers of our own service, that the German apparatus was far superior, as the Germans were so noted as scientists. Greatly to our surprise it was found that the German ships not only were equipped with inferior apparatus, but that they had not equipped their vessels along the line of most recent developments in direction finders, submarine listening-in devices, and sharply tuned instruments. These secrets must have been known to the Germans and the experts are at a loss to understand this lack of equipment on their vessels.

Recent naval radio development has been along the following lines:

(1) Radio compass, for taking bearings by means of received signals.

(2) Radio telephone.

(3) Radio applied to aircraft.

(4) Increased ranges for communication.

(5) Improvement in sharpness of tuning, resulting in larger number of simultaneous communications, without interference.

(6) Underwater reception of signals.
(7) Fire control by radio.

The Radio Compass.—A large number of ships, principally destroyers and transports, have been equipped with the radio compass. This instrument consists of a receiver and an aerial, the latter being merely a revolving coil about four feet square. When the coil is in the plane of the incoming signal, the apparent signal intensity is greatest. By this principle the bearing of an incoming signal can be measured, at distances up to about 50 per cent of the distance of ordinary reception from any particular transmitting station. The time consumed in taking a bearing is about one minute. The accuracy of the reading depends principally on the personnel. It takes several weeks of constant practice for an operator to become an accurate measurer of radio compass signals. At least once a year the curve of errors for the radio compass should be determined by swinging ship, in a manner very similar to that used for determining deviation for the standard compass. With a carefully calibrated radio compass, a gyro repeater mounted in the radio compass room for comparison, and an experienced operator, it is possible to obtain accuracy on board ship within one or two degrees.

There are shore radio compass stations near the entrances of each of the principal harbors on the Atlantic Coast, including Boston, Newport, New York, Delaware Capes, Chesapeake Bay entrance, and Charleston. A ship may call for position within 200 miles of any of these stations and obtain it with a fair degree of accuracy. The nearer the ship is to the compass station the more accurate becomes the position given by radio. It is reasonable to expect roughly an average of one-quarter mile error close in shore, one mile at a distance of 20 miles, two miles error at a distance of 50 miles, and four miles error at a distance of 100 miles. The fact that the radio compass bearing is fairly dependable should not in any way relieve the navigator of the ordinary precautions, such as taking soundings and reduction of speed when nearing port in thick weather.

From the foregoing it becomes evident that the adoption of the radio compass to naval use introduces a new factor which must be considered in naval strategy, for being able to obtain the location of a ship by means of radio means that there must be very little radio signalling carried on by opposing forces in war

time, if they desire to avoid being located accurately, by the other side.

By virtue of the use of radio telegraphy, it has become the practice for the force commander to shift his arrangement and disposition of forces quickly from time to time, as circumstances develop, merely by radio. The radio compass makes the use of radio increasingly dangerous, and requires more careful planning in conferences and written instructions in advance. Study must, therefore, be given to means of circumventing this situation. In the first place it may be desirable to detail special decoy ships for the purpose of using their radio in an endeavor to mislead the enemy as to the strategic intentions; secondly, the power used for tactical maneuvers must be limited to the range of visibility, in order that the force commander's signals may not be overheard by the enemy; and thirdly, it will be necessary to arrange that the necessary exchange of radio information, using high-powered transmission, be done by means of messages so brief that the opponent operators will not have sufficient time to adjust the compass for the purpose of obtaining a bearing. This may require the rearrangement of the signal book in such form that a short code word will be sufficient to transmit a considerable amount of information. Shifting widely between wave lengths at predetermined intervals may be of some assistance in avoiding the enemy's compass listeners, in this respect.

A careful and systematic arrangement must be developed by our own vessels, and by the establishment of additional listening-in compass stations, in order to insure that our operators may hear and locate the signals of any enemy craft which transmits by radio.

By virtue of the ability of the shore radio compass stations to give the navigator an accurate position regardless of visibility conditions it is possible for the fleet to make port under weather conditions which would otherwise render this difficult if not impossible. Therefore, the radio compass is an instrument which will greatly assist the commander-in-chief in greater freedom of movement by making quick retreat to a friendly port always possible.

Scouting airplanes and dirigibles are being equipped with radio compass outfits which will be of great assistance to these

vessels in returning to port, and in locating their mother ships at sea.

By using the radio compass it is possible easily to make contact possible between vessels of our own fleet, in thick weather. This instrument proved valuable in this respect, during the war, assisting escorts to make contact with troop convoys, contact in thick weather being a matter of chance without the radio compass.

The Radio Telephone.—This instrument has recently been supplied to practically all naval vessels, and has proved particularly useful for aircraft signalling, for maneuvering submarine hunting squadrons, and as a convenience in the fleet at anchor, for arranging about supplies, athletic events, etc., where flag signalling is too slow and cumbersome. Experiments are being made by the fleet to determine whether the radio telephone will prove superior to the radio telegraph for tactical maneuvers. In the course of two or three years the art will have sufficiently advanced to make possible simultaneous use of the telephone and telegraph, without interfering one with the other. At present this is not practicable, and the telegraph must be silenced when the telephone is in use and vice versa, when used on the same ship.

The telephone will probably be found to be inferior to the telegraph for strategical purposes due to the difficulty in speedily transmitting cipher and code by telephone as compared to the telegraph, also to the fact that military information may be more concisely and clearly transmitted by carefully worded message. The telegraph is less likely to err than the telephone. Therefore it would appear that the telegraph will always be the primary means of communication for strategical purposes, and probably for tactical purposes. For convenience in administration the telephone will undoubtedly prove superior to the telegraph, but the use of the telephone will have to be carefully regulated in order not to interfere with the telegraph, at least until the art has solved the problem of simultaneous use of both.

For aircraft, where saving in weight is such an important factor, the telephone is preferable to the telegraph, as an additional man as operator is not necessary, the pilot himself doing the talking. Possibly as aircraft becomes larger and the weight factor becomes less important, the same rules will apply to the use of the telephone *vs.* telegraph for aircraft, as for ships.

Small tactical groups of vessels, such as subchasers and aircraft used in hunting submarines, find the telephone indispensable, as much information of value can be quickly transmitted by telephone which would be impossible by telegraph, due to the special nature of the work.

The radio telephones installed on naval vessels are efficient for communication for ranges of 20 miles, often much greater; those on subchasers and smaller craft for ranges of 10 miles. One of the transports carries an experimental radio telephone capable of transmitting voice 800 miles.

Radio Applied to Aircraft.—Airplanes and dirigibles used as scouts are dependent upon radio to provide communication with their flagships and with the bases on shore. Spotting planes are equipped with radio for reporting fall of shots.

Two types of apparatus are furnished airplanes; short range (5 miles range) telephone transmitters for use in spotting planes and for maneuvering planes in formation; and long range combined telephone-telegraph transmitters for use in scouting machines. The latter have a range of roughly 150 miles when using telegraph. When using telephone the range is reduced to about 75 miles due to the difficulty in receiving telephone through the noise of the airplane motors. Dirigibles are equipped with 200-mile range transmitters, combined telephone-telegraph type.

A direction finder (radio compass) is now being supplied the latest type airplanes. By means of this instrument airplanes should be able to navigate back to their bases and mother ships in foggy weather. The airplane radio compass is efficient up to ranges of 75-100 miles when receiving from ordinary coastal and ship stations.

The principal influence on strategy, because of radio on aircraft, is to increase the radius of action of the airplane as a scout. Its value in tactics concerns the quick and accurate report of fall of shots. Spotting by aircraft observers will increase the accuracy of fire two or three hundred per cent, providing the radio is skillfully used.

Increased Range of Communication.—The range of radio has been greatly increased in the past two years due to the improvement in amplification of signals in the receiver and in anti-static antennæ, also to increased efficiency in transmitters. Battleships, flagships, cruisers, and fuel ships have been equipped with arc

type transmitters having reliable transmitting ranges of 800 miles by day (1500-2500 miles by night). A certain proportion of destroyers are being equipped with arc type transmitters which may be expected to give reliable ranges by day of at least 500 miles (over 1000 miles by night). The majority of destroyers have a reliable radio range of 300 miles by day. Improvements in receiving arrangements at shore stations has made reliable trans-oceanic communication possible. This is important from a strategical standpoint, as cables are very easily interfered with by submarines. It is not only possible for a submarine to cut a cable but it is a simple matter for the submarine to listen in, by inductive means, to the cable conversations, thereby intercepting the messages. This should be borne in mind in war time, and great care given to the careful enciphering of confidential cable messages. The efficiency of the trans-oceanic radio service has advanced to the stage wherein active competition with cable lines is practicable. Whether the radio will ultimately replace the cables is a matter of conjecture. Radio communication is cheaper than cable communication due to low initial and maintenance costs. The future of radio in this connection depends largely on whether the advance in the art will be sufficient to accomodate sufficient numbers of pairs of communication without causing too much interference.

Underwater Signalling by Radio.—It is now possible for submerged submarines easily to receive radio signals from ships, shore stations, etc. Efficient reception underwater from aircraft in flight is not yet practicable. A submarine can cruise with its aerial submerged 10-20 feet below the surface and overhear the various radio conversations which are carried on. To date no means have been developed by which the submarine effectively transmits radio signals using a submerged aerial.

Use of Radio for Fire Control.—Radio is of great value for fire control purposes generally, not only for airplane spotting in the fleet, but for artillery spotting on shore, and for concentrating the fire of several batteries on one target, also for exchanging ranges between fire control stations. Difficulties due to interferences between many stations operating within limited areas are being overcome by replacement of old type apparatus with modern continuous wave sets, and the addition of directional receiving aerials.

The use of radio for military purposes and for commercial purposes is increasing with rapid strides. The control of the aerial torpedo by an airplane is pretty well perfected, and there is considerable hope that an underwater torpedo controlled by radio from a guiding airplane will develop as a useful weapon. The limit of power of large caliber guns seems to have been about reached and for longer accurate ranges the radio controlled torpedo is the logical line of development, therefore our tactics and strategy should be guided with this in mind. We must look to the day when the aircraft, radio, torpedoes and submarines play most important rôles in naval warfare.

The use of the various radio facilities which are possible is dependent entirely on skilled personnel. It is absolutely essential that the radio officer of each capital ship, and of each flotilla or group of destroyers, submarines and aircraft, be a skilled operator and constantly on the "wire." Failing in this no advance is possible. Flag officers can do the greatest good in advancing present day development by taking a keen interest in insisting on this important point. The whole future of strategy, tactics, information, fire control, and torpedo control is absolutely dependent upon radio telegraphy and radio telephony. This must be recognized and suitable provision made properly to develop personnel, material and operation plans to anticipate the situation.

RADIO COMPASS STATIONS

ATLANTIC COAST

Cross Island, Maine.
Bar Harbor, Maine.
Damiscove Island, Maine.
Appledore Island, Maine.
Gloucester, Mass.
Deer Island, Mass.
Fourth Cliff, Mass.
Cape Cod, Mass.
Nantucket, Mass.
Chatham, Mass.
Price's Neck, R. I.
Watch Hill, R. I.
Montauk, L. I., N. Y.
Fire Island, N. Y.
Rockaway Beach, N. Y.
Sandy Hook, N. J.
Mantoloking, N. J.
Cape May, N. J.
Cape Henlopen, Del.
Bethany Beach, Del.
Hog Island, Va.
Smith Island, Va.
Cape Henry, Va.
Cape Hatteras, N. C.
Cape Lookout, N. C.
North Island, S. C.
Morris Island, S. C.
Burrwood, La.
Pass a Loutre, La.
Grand Island, La.
St. Augustine (Projected).

PACIFIC COAST

Point No Point, Wash.
Admiralty Head, Wash.
Smith Island, Wash.
Cattle Point, Wash.
Lime Kiln, Wash.
New Dungenes, Wash.
Slip Point, Wash.
Tatoosh Island, Wash.
Ozette Island, Wash.
Ocean Park, Wash.
North Head, Wash.
Tillamook Head, Wash.
Fort Stevens (Clatsop Spit), Oregon.
Cape Arago, Calif.
Eureka, Calif.
Point Reyes, Calif.
Farallon Islands, Calif.
Bird Island (Point Bonita), Calif.
Point Montara, Calif.
Point Arguello, Calif.
Point Conception, Calif.
Point Hueneme, Calif.
Cape Avalon (Santa Catalina), Calif.
Point Loma, Calif.
Chy, Calif. (Imperial Beach).

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THE *ST. LAWRENCE* AND THE *PETREL*

By James Morris Morgan

Few people now living are aware of the fact that the states of Louisiana and South Carolina had navies separate from the Confederate States and fewer still know that people in the Confederacy fitted out privateers, but imagine that it is the proper thing to call the de facto government-owned ships, such as the *Alabama*, etc., "privateers." Now a privateer is of course a vessel owned by a private party and sails under the protection of a "letter of marque" to prevent their crews from being treated as pirates in case of capture. The United States Government settled the matter to its own satisfaction by branding everything afloat which belonged to the Southern Confederacy as pirates—and this brings about an interesting question, as it is well known that the definition of a man-of-warsman or navy sailor is "a sea soldier" or "a soldier that fights on water." Now it was all right for the soldiers of General Sherman's army to burn hundreds of houses on their "march to the sea," because, I suppose, the houses were on land, but it constituted an act of piracy according to the government of these same soldiers when a Confederate sailor burned a ship on the high seas; and what is a ship if it is not both a dwelling and a floating warehouse? Now to follow out this line of reasoning to its natural conclusion: if a soldier belonging to a "de facto" government becomes a pirate when he goes in a boat on the water, then naturally every time General Lee's army crossed a river on pontoon bridges by that act they also became a band of pirates. But I am drifting away from the South Carolina navy.

Prior to the Civil War the United States Government had a class of revenue cutters that were unique in their yachty appear-

ance. They were, of course, small, being topsail rigged schooners, and as they were built to catch smugglers naturally they were exceptionally fast. One of these cutters, the *Petrel,* was stationed in Charleston harbor at the time of the secession of the state and was at once seized and turned over to the South Carolina navy. The armament of the *Petrel* consisted of one 18-pounder, or "Long Tom" as the little gun was affectionately called by the sailors. This gun was mounted forward of the foremast.

A very young master's mate with more enthusiasm than experience was given the command and he put to sea in great haste as he feared that two local privateers, a little brig called the *Jeff Davis,* and a little tug, mounting one 32-pounder, called the *Lady Davis,* which were cruising outside of Charleston bar, would gobble up all the prize money before she, the *Petrel,* would be able to get in her fine work.

Getting into the Gulf Stream the *Petrel* cruised for days without success until one day her boy commander saw what he was sure was fortune, coming fearlessly toward him, in the shape of a big East-Indiaman with dirty sails and yards all askew; and what made the youngster doubly sure of his prize, was the way in which the ship was painted, black with a white stripe around her in which was painted camouflage black gun ports. All East-Indiamen used this deception to make them resemble (at a distance) frigates and the Chinese pirates were supposed to take fright at the sight, and instantly seek safety in flight. But the supposed disguise did not intimidate the *Petrel's* young captain a bit. He gallantly bore down on the supposedly doomed ship and signaled her to "heave to," to which signal the big ship paid no attention. Then more sail was set on the *Petrel* and she easily headed the lumbering old craft. When she got to within some 300 yards of her a shot from the Long Tom was sent across the supposed Indiaman's bows as a peremptory notice that she had been ordered to stop!

"Rien n'est sacré pour un Sapeur," as the French poilu said when he picked the lady's lap dog up by the tail—and the tale of what followed that shot which went skipping over the waves is more dramatically and tersely told in the language of the *Petrel's* boy skipper when a lot of irreverent midshipmen insisted upon his giving them a full description of that memorable combat in

which he had borne such a conspicuous part. His account of the engagement was as follows:

Just as I fired the shot across the bows of the supposed old water bruiser her whole side seemed to fall apart and for an instant I saw a sheet of flame reaching from her stem to her stern followed by a terrific crash and roar as of thunder. I distinctly felt a jar, and after a time I came up spouting water like a half-drowned whale. And that is all I know about the fight between the United States 50-gun frigate *St. Lawrence* and the Confederate States 1-gun cruiser *Petrel.*

While in the Gulf of Mexico the *St. Lawrence* had heard of the doings of the toy cruisers or privateers in the Gulf Stream off Charleston and she proceeded to investigate, but her commander never dreamed that his camouflage to look like an Indiaman would succeed to such an extent that a toy boat like the *Petrel* would sail up to within a few cable lengths of the frigate without discovering the ruse, and then boldly open fire on a fighting ship much more than 50 times her superior.

The youthful commander of the *Petrel* realized the truth of the old yarn about the sailor who once "got religion" and while reading his Bible came across the verse which says that "those who go down to the sea in ships see the wonders of the Lord." He stopped and scratched his head and after cogitating for a while he said: "Well of course that must be so as everything in this book is true, and now that I come to think about it I never did make a voyage in a full-rigged ship, but I can tell the fellow that wrote that this, and that is, that those who go to sea in barks, brigs, schooners or other small craft—they see hell!"

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AN APPLICATION OF THE METHOD OF ANALYZING THE ENGINEERING PERFORMANCE OF DESTROYERS

By Lieut. Commander Wentworth H. Osgood, U. S. Navy

I. Outline of Article

This article is written with the purpose of explaining by means of definitions and specific examples the elements which, taken together, constitute a complete analysis of the engineering performance of destroyers; the object being to give simple and practical explanations of these elements, in order that they may be used daily aboard ship toward the more efficient and economical operation of the engineering plant.

The following outline will be pursued: The units and terms employed will be defined as they apply to the subject-matter, rather than the absolute scientific definition. Practical values of the foregoing defined characteristics will be given for each machinery unit by means of the simplest and most useful curves that can be employed. A concrete example of performance will be given and worked out. This will be explained, the explanation serving to show the method of handling the data, and the detection of faults in the operation by means of this analysis. Finally, suggestions for the practical application of this analysis aboard ship will be given. The installation aboard the U. S. S. *Blakeley* (150) is the basis of the analysis.

II. Units and Terms Employed

The units and terms as defined below are in the simplest and most useful form for this analysis. It is understood that most of these terms and units should be corrected for the various conditions other than the standard conditions to which all test results are reduced for comparison. For the actual use of this method aboard ship these corrections are omitted, but in case the informa-

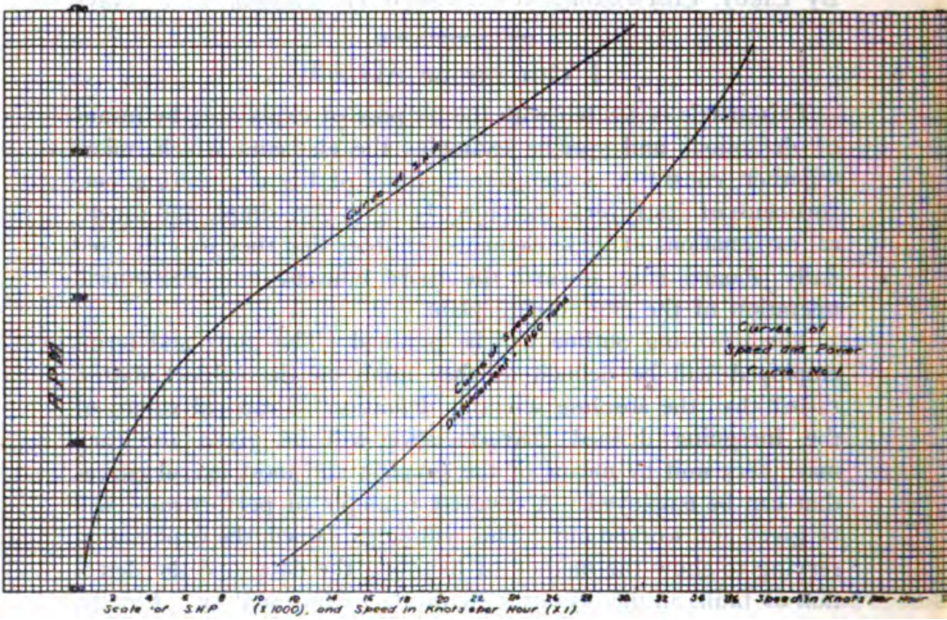
tion is desired it can be found in the standard engineering handbooks and especially in the Power Test Code of the A. S. M. E.

1. UNITS EMPLOYED

Notation for Power Formulæ

P = Mean effective pressure from indicator in pounds per square inch.

P_1 = Mean effective pressure of the air end of compressor.



L = Length of stroke in feet.

A = Area of piston less one-half area of piston rod in square inches (net area).

N_1 = Number of single strokes per minute.

N_2 = R. P. M. or double strokes per minute.

W = Net weight or pressure on brake arm in pounds.

L_1 = Effective length of brake arm in feet.

[1] H = Total head in pounds per square inch.

[1] This total head H is made up of the pressure in the suction line being added to the pressure of the discharge side of a pump.

H_1 = Head as above, in feet.
Q = Quantity of water in pounds per hour.
Q_1 = Quantity of water in gallons per minute.

$$Q = 7.20\ Q_1 \text{ (fresh water)}.$$
$$Q = 7.02\ Q_1 \text{ (salt water)}.$$

One horsepower = 33,000 foot pounds per minute.
One horsepower = 550 foot pounds per second.

Indicated Horsepower

$$\text{I. H. P.} = \frac{PLAN_1}{33{,}000} = PN_1\left(\frac{LA}{33{,}000}\right).$$

Brake Horsepower

$$\text{B. H. P.} = \frac{\pi W L_1 N_2}{33{,}000} = WN\left(\frac{\pi L_1}{33{,}000}\right).$$

Water Horsepower

$$\text{W. H. P.} = \frac{HALN_1}{33{,}000} = HN_1\left(\frac{AL}{33{,}000}\right).$$

$$\text{W. H. P.} = \frac{Q_1 \times H_1}{K}.$$

$$\text{W. H. P.} = \frac{Q_1 \times H}{K_1}.$$

	Salt water	Fresh water
K	3890	3860
K_1	1680	1710

Air Horsepower

$$\text{A. H. P.} = \frac{P_1 ALN_1}{33{,}000} = P_1 N_1\left(\frac{AL}{33{,}000}\right).$$

NOTE.—The above formulæ can be used for reciprocating compressors. The air horsepower of the fire-room blowers is found from formulæ that contain elements which require special measuring apparatus (not supplied to ships).

The "pound of steam" is taken as the unit of energy input. The real energy is the number of B. T. U.'s of heat contained in the pound of steam at the existing pressure; this value can be found in any steam tables or handbook; but as the steam is the actual medium that is measured and which the boiler gives off, even though it is just the "carriage" for the actual energy, it is the one used to represent the input.

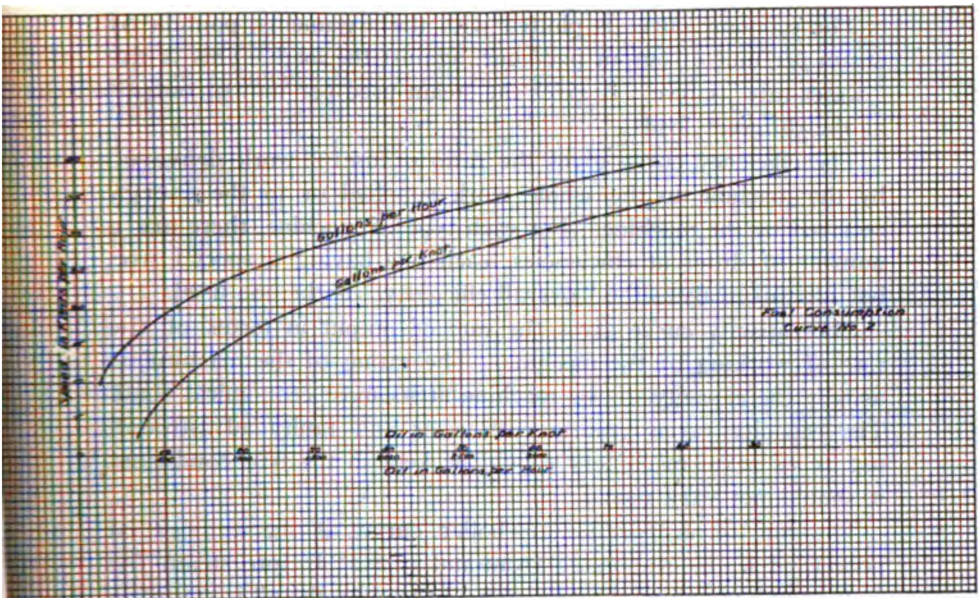
The "water rate" is the number of pounds of steam that a machinery unit uses in a unit of time, usually an hour. As an

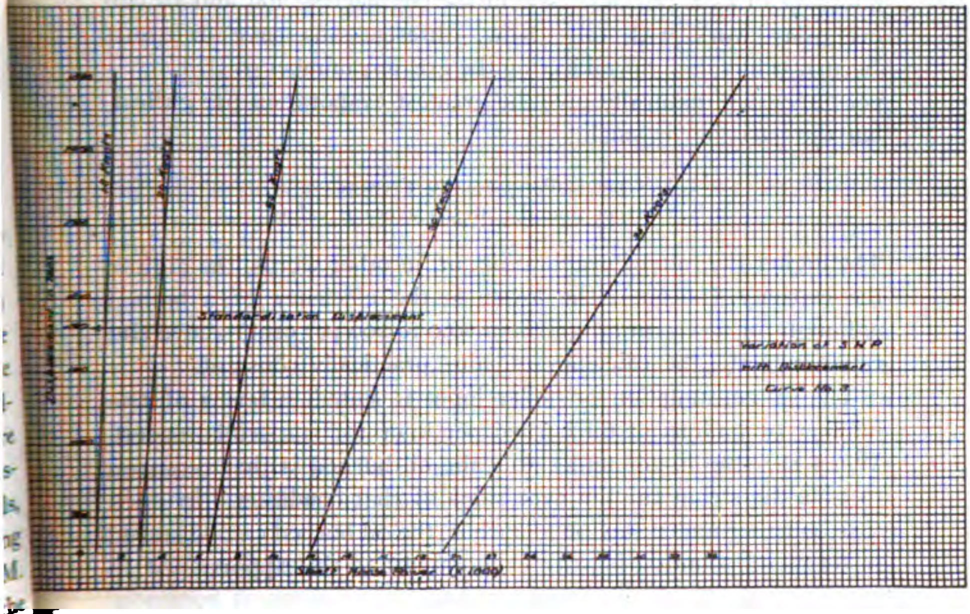
example, if a pump has a water rate of 50 pounds per horsepower hour at a certain pressure and rate of output, it means that 50 pounds of steam at a pressure of, say 200 pounds, is being supplied to the pump each hour for each I. H. P. The heat which actually does the work is caried by the steam and from the steam tables amounts to 1198 B. T. U.'s per pound. Therefore $50 \times 1198 = 59{,}900$ B. T. U.'s are supplied to do the work of each I. H. P. Although much of this heat is wasted owing to the unavoidable inefficiency of the machine, nevertheless, it is the energy supplied or the input.

The criterion of the final performance should always be the "gallons per knot"; that is, the number of gallons of oil that are required to drive the ship a distance of 1 knot at the various speeds as defined above. This states, in other words, that so many gallons of oil burned under the boiler supplied just enough steam for the main engines and all necessary auxiliary machinery (including generators for lighting, etc.) to drive the ship a distance of 1 knot at a speed of so many knots per hour. Naturally, the faster the ship goes, the more oil will be required to go the same distance. This is shown on Curve 2. For other than standard trial displacements the relation between the horsepowers required are shown on Curve 3.

2. TERMS AND THEIR INTERRELATIONS

The Willan's line is a curve plotted with the arguments, "input," or total steam used per hour, and "output," or the work done by the machine, expressed in appropriate units. The output of a generator is in kilowatts; of a pump, in gallons per minute; and of an engine, in horsepower, etc. The load or output (abscissa) should be given in terms of revolutions or strokes of the machine as these are easily determined. This can be done since all of the machines work under practically constant conditions. The feed-pump works against the boiler pressure of 260 pounds. A fire and bilge pump when on the flushing system runs steadily at a pressure of 10 or 15 pounds, and when on the fire main at 70 pounds, and so on. The main turbines at a specified R. P. M. are pushing against a steady load. In other words, the strokes or R. P. M. of a machinery unit can be taken as the direct measure of the power developed. (See capacity curve.)


Gallons per Hour
Gallons per Knot
Fuel Consumption
Curve No. 2
Oil in Gallons per Knot
Oil in Gallons per Hour


Standard Trial Displacement
Variation of S.H.P.
with Displacement
Curve No. 3
Shaft Horse Power (x 1000)

The economy curve is plotted with the arguments, pounds of steam per unit of output per hour, against the load. This is the "water-rate" curve. It gives the steam used per unit of output at the different loads.

The efficiency curve gives the ratio of useful work delivered by the machine to the whole work supplied or to the energy received by the machine. For each type of machine, there are a number of different efficiencies, each one having a special use, but for this analysis the "overall efficiency" is the one used.

The capacity curve gives the rate of output in terms of the rate of working of the machine. The rating of the machine is usually the capacity of the machine at its most economical load The capacity varies greatly with wear and faulty adjustment, but as all naval machinery should be kept in the best condition. it should not vary much.

The rate of evaporation or boiler output is the number of pounds of water evaporated from and at 212° F. into steam for each pound or gallon of oil burned. In testing, the oil is stated in pounds, but in the practical work the gallon is the more useful unit, since this is the unit used in the engineering log and in the every-day work with oil. Now, different oils have different thermal values, and the oil having the greatest number of B. T. U.'s per gallon will naturally give the greatest evaporation per gallon, but the variation is small.

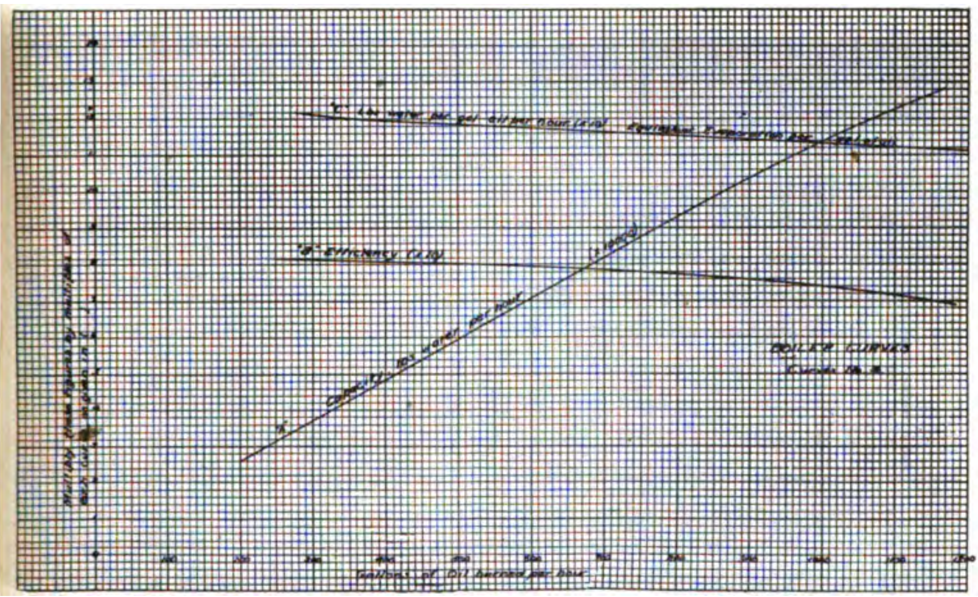
B. T. U.'s per gallon=144,670 average value.
B. T. U.'s per pound= 18,500 average value.

The higher the rate of evaporation, or, in other words, the higher the capacity (output), the lower is the efficiency of a boiler, although for a certain range (from 100 to 200 per cent) above the rated capacity, the efficiency remains practically constant.

The oil consumption or boiler input is stated in terms of the number of gallons of oil burned per knot for a specified speed. When the ship is not under way the oil burned is that required to give the steam for the necessities of that condition. In each case, whether under way or at anchor, the oil burned can be stated in terms of pounds of water evaporated and this apportioned to the various machines which take steam.

III. ACTUAL VALUES OF INTERRELATIONS

Actual values of the foregoing interrelations are given by means of the following curves for each machinery unit: (a) Willan's lines; (b) economy curve; (c) capacity curve; (d) special curves for boilers. These values are mainly from the data supplied by the builders, from the results of tests at the Naval Experimental Station where possible, and from the standard textbooks and handbooks. In all cases the curves are plotted with the load or

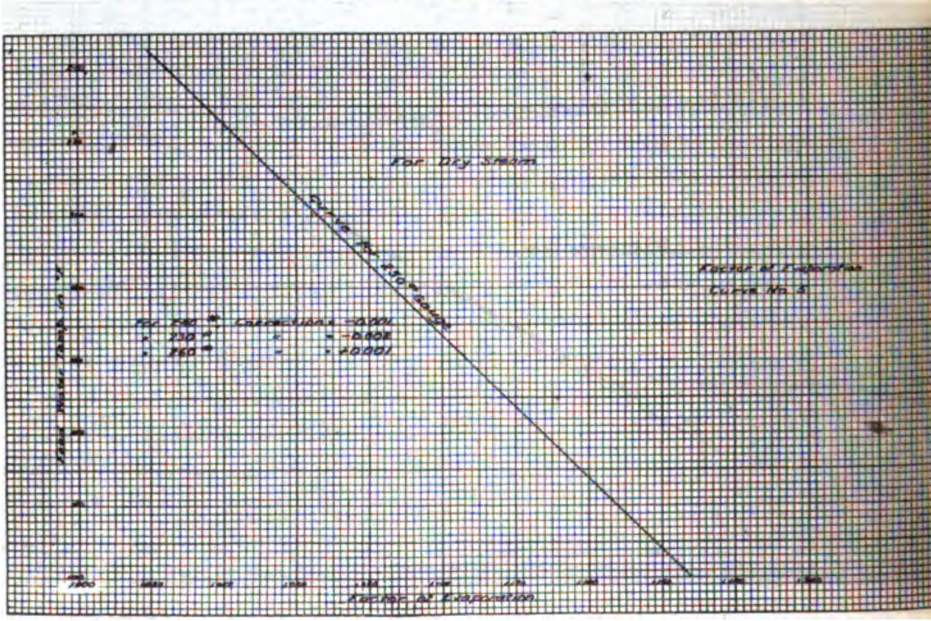


output as the abscissa and the opposite argument as the ordinate. In actual operation these values are rarely obtained, but the effort should be made to approach them.

The following considerations will give some idea of the assumed conditions that also govern these values. The best possible vacuum is maintained for the main turbines; curves of correction for other vacuums are given. All the auxiliary machinery operates against a back pressure, usually of 10 pounds gauge, which increases the steam consumption of each unit about 8 to 15 per cent. The given curves are for the operating conditions:

Boiler Data.—The expenditure of oil for the 24 hours is obtained from the oil meters or by soundings; in the former, it

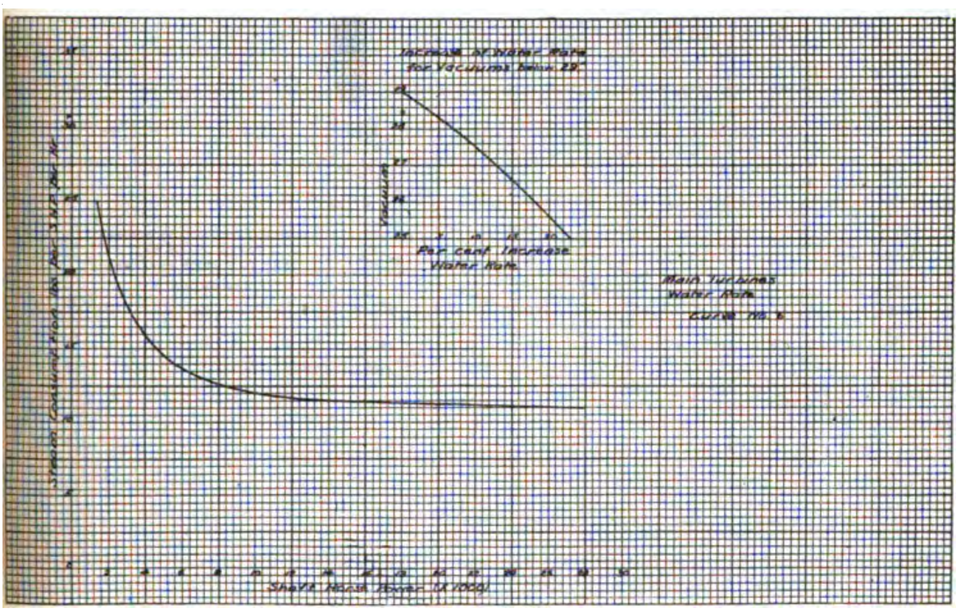
should be corrected for the error of the meter. The hourly expenditure is obtained from the total oil burned. Using the hourly rate, find from curve *C* of the boiler curve sheet (Curve 4) the water evaporated per hour from and at 212° per gallon of oil burned. This quantity times the total number of gallons of oil burned will give the total equivalent evaporation for the 24 hours. Find the factor of evaporation from Curve 5, entering with the feed-water temperature and applying the tabulated correction for other than the boiler pressure of 250 pounds gauge. (The factor



of evaporation $=\frac{H-h}{970.4}$, where H is the total heat in a pound of dry steam at boiler pressure and h is the heat in a pound of feed water above 32° F. This is for dry and saturated steam.) The total equivalent evaporation divided by the factor of evaporation will give the pounds of water actually evaporated under the existing conditions. Example:

Oil for 24 hours	7,800 gallons
Oil for 1 hour	325 gallons
Equivalent evaporation per gallon from curve	120 pounds
Total equivalent evaporation	936,000 pounds
Steam pressure	250 pounds
Feed temperature	230°
Factor of evaporation	1.034
Actual evaporation per hour	905,200 pounds

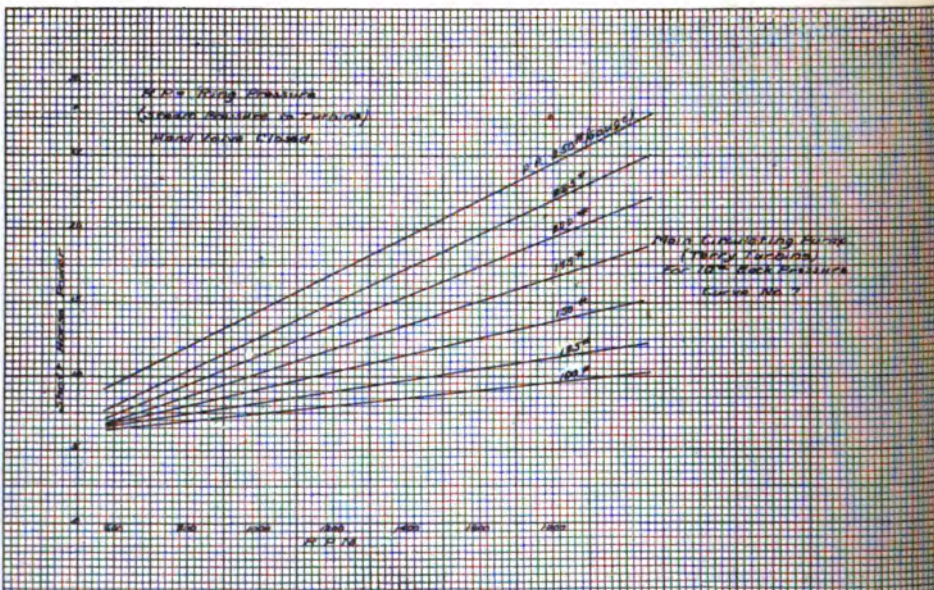
Main Turbines (*Parsons*).—The water-rate curve of the main turbines is given, as its use is more accurate than the use of the Willan's line plotted to the scale of these curves. The power is the total shaft power and the water rate is for the two shafts (four turbines). To secure a certain speed of the vessel through the water a definite number of R. P. M.'s are necessary for a given displacement. To give these revolutions the turbines must develop a definite shaft horsepower. With different displacements different speeds will result from the same R. P. M. or shaft horsepower.



To get the steam used by the turbines enter Curve 1 with the R. P. M. and find the S. H. P.; entering Curve 6 find the water rate for this developed S. H. P. The total S. H. P. multiplied by the water rate will give the total pounds of steam used per hour by the turbines. There are losses of steam through the glands, but with the "feather of steam" called for, instead of the "Channel Fog Bank" sometimes seen, this loss will be relatively small. The increase of the steam rate with vacuums below 29 inches can be found from the insert of Curve 6.

Condensing Plant.—The operation of the main condensers requires the services of one or two main air pumps and two circu-

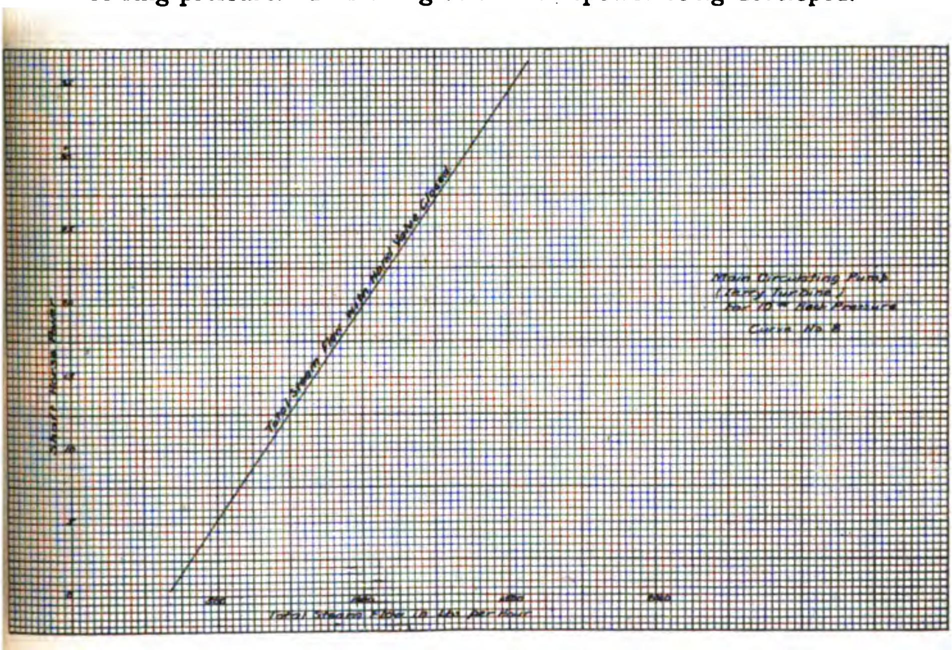
lating pumps if the ship is not making enough way through the water for the scoops to operate. The air pumps run continuously while under way and daily for a short period, perhaps an hour, while at anchor. Under the first condition they develop 8 to 9 H. P., while in the second case the horsepower amounts to 1 or 2. The circulating pumps run while warming up and are necessary up to a speed of about 15 knots, when the scoops take charge. Even then it is sometimes advisable to keep the circulators turning



over. While turning over at about 400 R. P. M. the turbine develops about 5 to 6 B. H. P. and when actually working, at around 1500 R. P. M., about 15 to 16 B. H. P. are developed when the water has free flow through the condensers. In both cases the actual strokes or revolutions should be used in entering the curves to get the steam consumption.

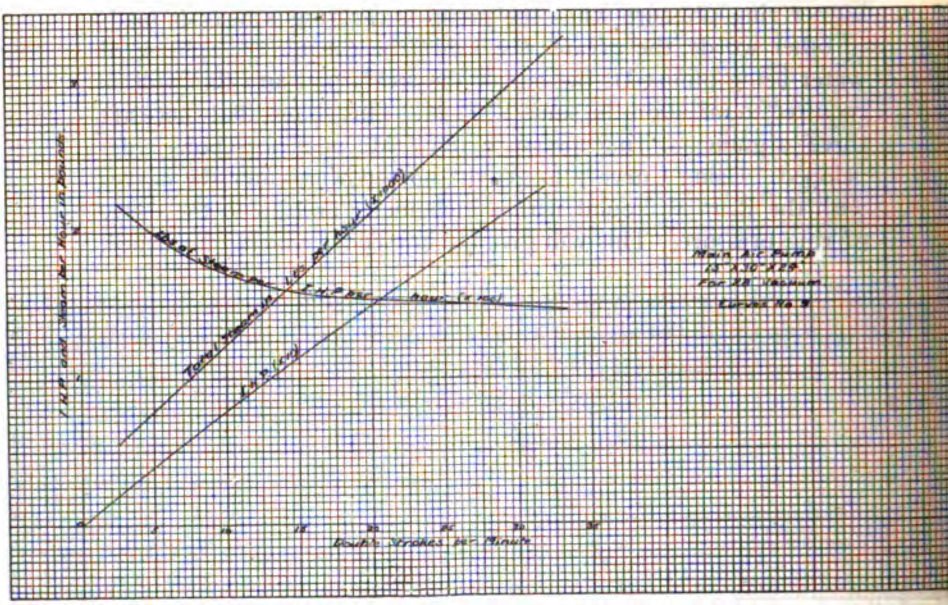
Since the circulator is a centrifugal pump, the power developed cannot be taken directly from the R. P. M. The pumps can be driven at a certain number of R. P. M. by a low "ring pressure" (or the pressure of the steam to the pump turbines) when lightly loaded, but the same number of R. P. M. can be obtained with a

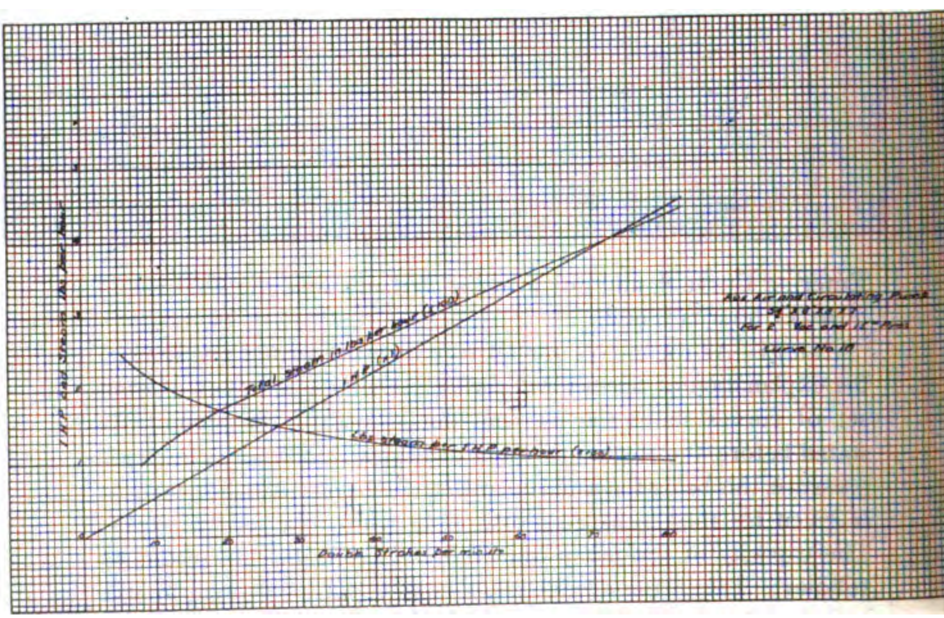
higher ring pressure when the pump is carrying a heavier load; in other words, the greater the load (the greater the volume of water being pumped), the higher the steam pressure that will be required to maintain the same R. P. M. This shows that there are three arguments, ring pressure, R. P. M. and horsepower developed. Using Curve 7 to get the horsepower, enter the curves with the R. P. M. found with a tachometer and go to the curve of ring pressure. This will give the horsepower being developed.

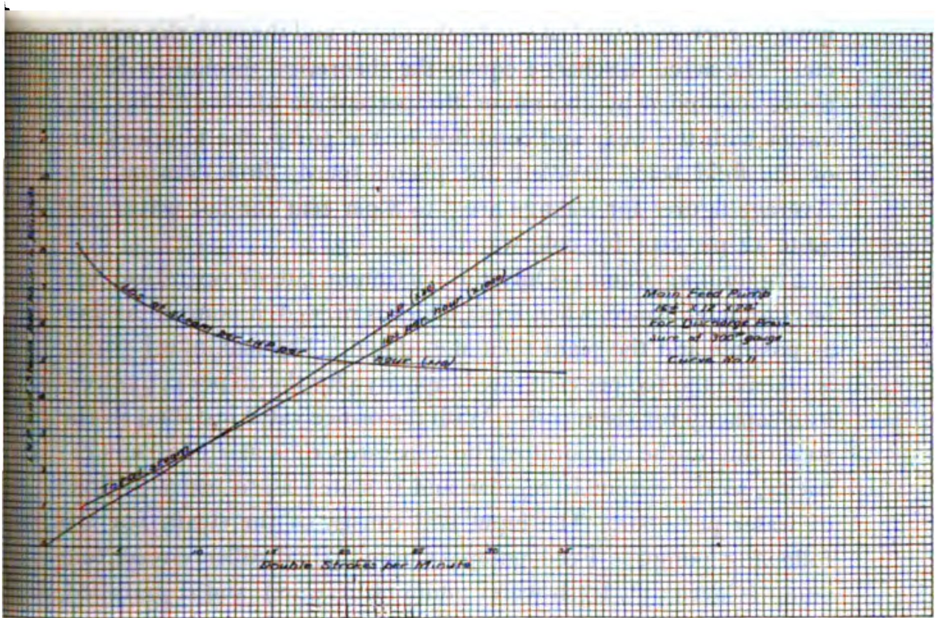


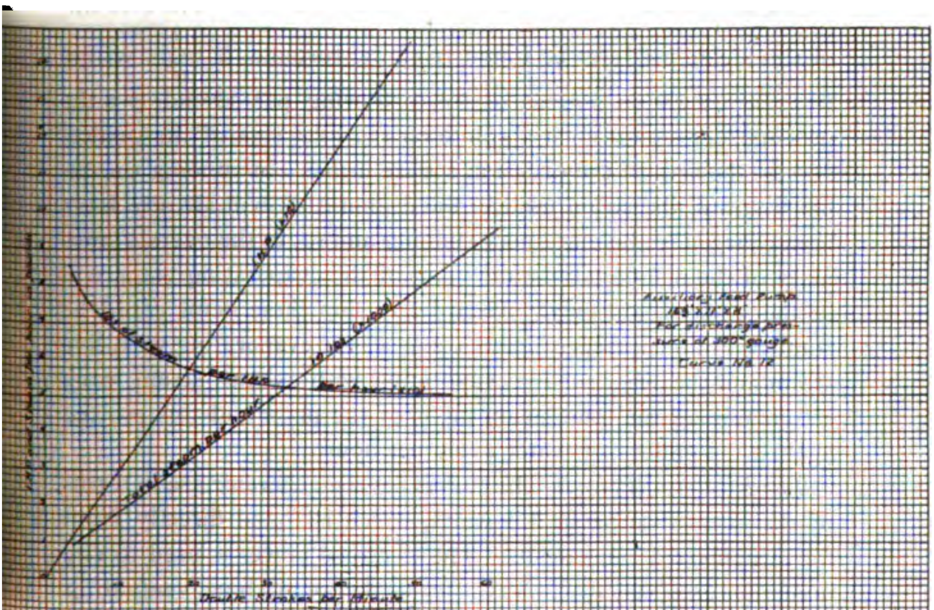
Entering Curve 8, and going to the Willan's line, the total steam flow per hour is found.

Pumps—As the curves for all reciprocating pumps are similar, the explanation of one set will suffice for all. The legend of each set of curves states the use and dimensions of the pump. As stated before, the steam quantities are for a 10-pound gauge back pressure, this being the usual operating condition. The horsepower is given for the discharge pressure at which the pump works. The capacity of the pump can be found from the dimensions as follows: The piston displacement in cubic inches divided by 231 will give the theoretical discharge in gallons per single stroke; this


Main Air Pump
Curves No. 9
Double Strokes per Minute


Aux Air and Circulating Pump
Curve No. 10
Double Strokes per minute

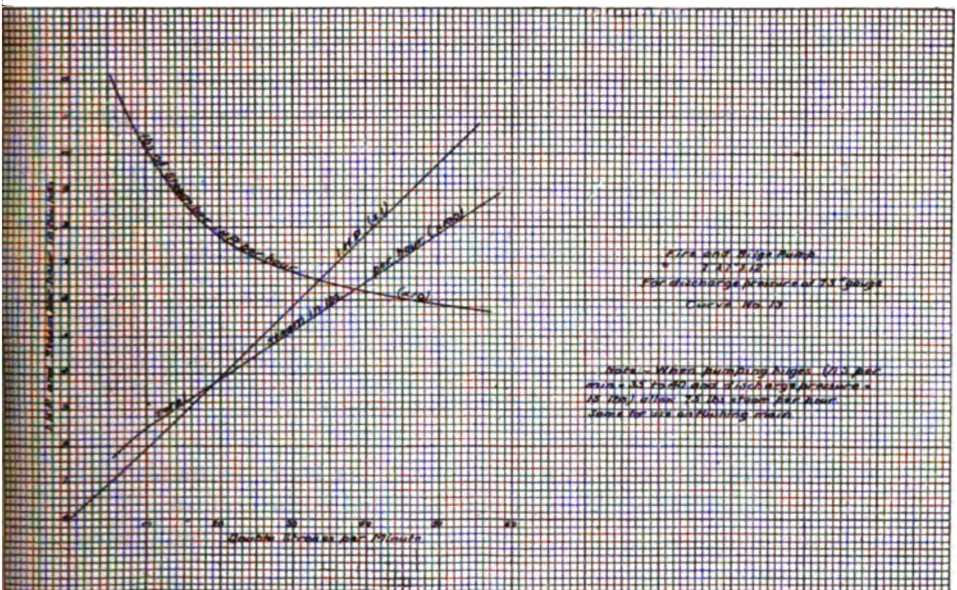

Main Feed Pump
Curve No. 11
Double Strokes per Minute

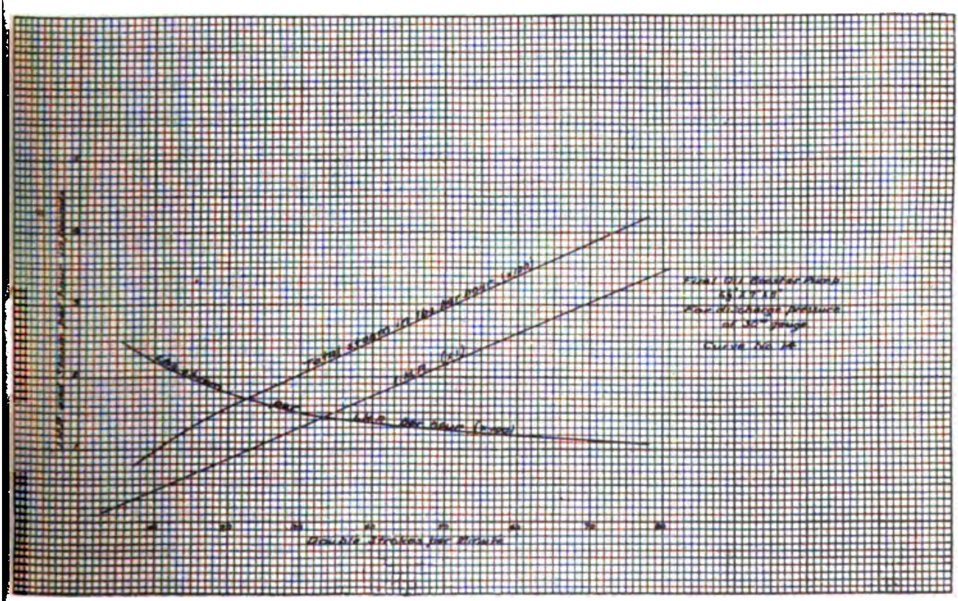

Auxiliary Feed Pump
Curve No. 12
Double Strokes per Minute

must be corrected for leakage by the piston and through the valves, etc. The actual discharge equals the theoretical discharge found above multiplied by 100 minus the percentage of slip. This slip varies with the wear and condition of the pump, the temperature of the fluid being handled, the piston speed, fluid density, etc. Average figures for leakage are 5 to 8 per cent for hot water and 12 to 14 per cent for cold water.

Evaporating Plant.—Only the maximum rate of operation will be considered, since, when fresh water is needed, it is made as fast as possible and the plant then shut down. The maximum rating is taken as the 100 per cent rated capacity plus the 40 per cent overload capacity for clean coils. With the orifice valve installed in the steam line to the evaporator, the apparatus runs at a constant capacity, so the output is regular and is stated as so many gallons of water per hour. The input will consist of the steam for the following pumps: Feed pump (Curve 19), distiller circulating pump (Curve 13), fresh-water pump (Curve 18), and if installed, the distiller vacuum pump (Curve 18); also, if running on live steam, the steam required for the actual evaporation. The amount of this steam used can be found from the formula, $W=\frac{pa}{70}$, where W = the weight in pounds of steam flowing per second, p = the pressure per square inch absolute on the inlet side of the orifice, and a = the area of the orifice in square inches. If running on exhaust steam, the steam used in the evaporators will already have been charged to the machinery running and so, in the overall summary of the plant analysis, the input of the evaporating plant will be the pump steam only. Aboard any ship these items could be combined into two sets of curves, one set for evaporating with live steam and the other set for evaporating with exhaust steam, each set containing the total steam input of the plant and this plotted against the gallons of water made per hour.

The Electrical Plant.—The curves for the generator are in terms of the rate of output in kilowatts, which is found directly from the switchboard instruments. The electrical power is used to run numerous auxiliary machinery, such as the ice machine, ventilating motors, for lighting, etc. The approximate number of amperes


Fire and Bilge Pump
Curve No. 13
Double Strokes per Minute


Fuel Oil Booster Pump
Curve No. 14
Double Strokes per Minute

that each of these circuits takes is listed below, but the only item needed in this analysis is the total output in kilowatts per hour.

Circuit	Load amp.	Circuit	Load amp.
Lighting aft—battle	7.65	Oil separator	15.00
Lighting eng. rm. stbd	12.10	Lighting fwd.—battle	53.69
Lighting eng. rm. port	11.00	Radio	80.00
Lighting boiler rms. stbd	11.30	Call bells	1.00
Lighting boiler rms. port	14.88	Broadside "follow pointer"	4.00
Lighting aft—general	19.25	Voice-tube calls	1.00
Vent. blower fwd	14.00	Loud-speaking telephones	1.00
Vent. blower aft	18.00	Director firing	3.00
Aux. radio rm	5.00	General alarm	6.00
Lighting fwd.—general	37.26	125-v. motor generator No. 1	25.00
Machine shop } Refrig. machine }	46.00	125-v. motor generator No. 2	25.00
		Gyro-compass	?

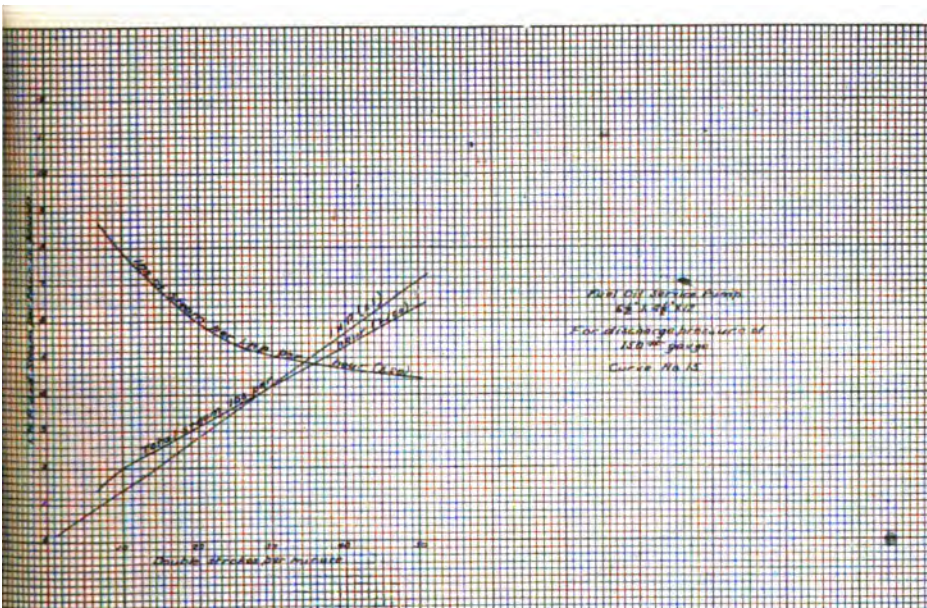
Entering Curve 20 with the kilowatts per hour, the number of pounds of steam per kilowatt hour is found as the ordinate. This figure multiplied by the load in kilowatts will give the steam used per hour.

Forced-Draft Blowers.—Since fans are of the centrifugal type, there can be different numbers of R. P. M. for a constant-inlet steam pressure according to the load on the fan; that is, the inlet pressure must increase in a certain relation as the load on the fan is increased if the revolutions are to be kept constant. In practical operation the arguments at hand are the R. P. M., steam-inlet pressure, and static pressure of the air,—the first two being sufficient to work with. Entering Curve 21 with the R. P. M. and the steam-inlet pressure, the S. H. P. being developed by the turbine is found, and from Curve 22 the steam consumption per S. H. P. per hour is found. The product of these two quantities gives the total steam used per hour by one blower set.

Steering Engine.—Owing to the intermittent working of the steering engine and the various powers developed when working, due to the various speeds of rotation, the best way to handle the steam consumption of this unit is to allow a number of pounds of steam per hour of operation. This number will vary over very wide limits, but a fair estimate would be about 200 pounds per hour during steady steaming. This figure is only approximate at the best; a practical and much better figure could be found aboard ship by running a simple test on the engine itself.

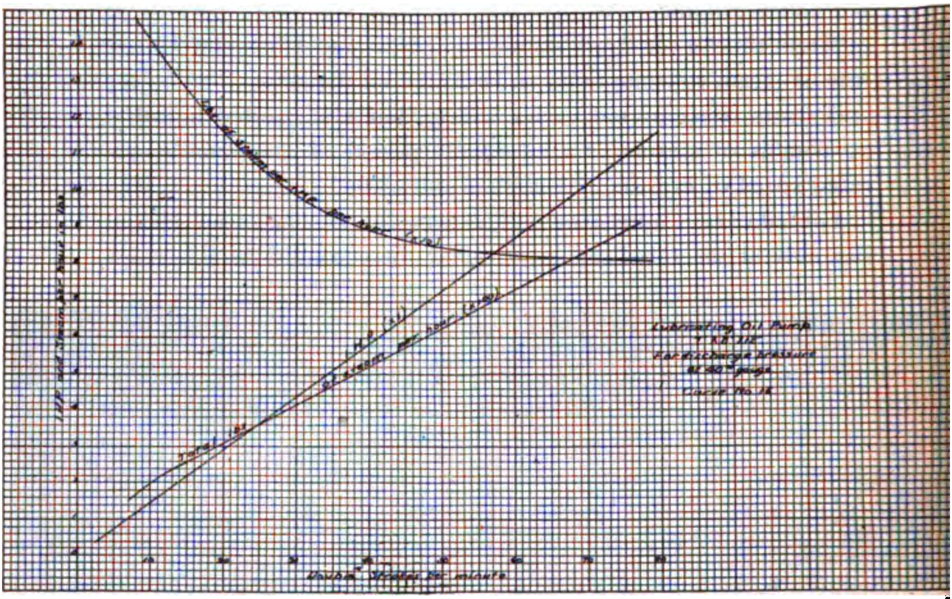
Anchor Engine.—As this unit is used for short periods at different times a set figure should be adopted until the approximate rate of steam consumption can be found on the ship. The power and steam consumption varies widely, but a suggested figure is 30 pounds of steam for a 15-minute period of operation at the rated speed of hoisting the anchor and chain.

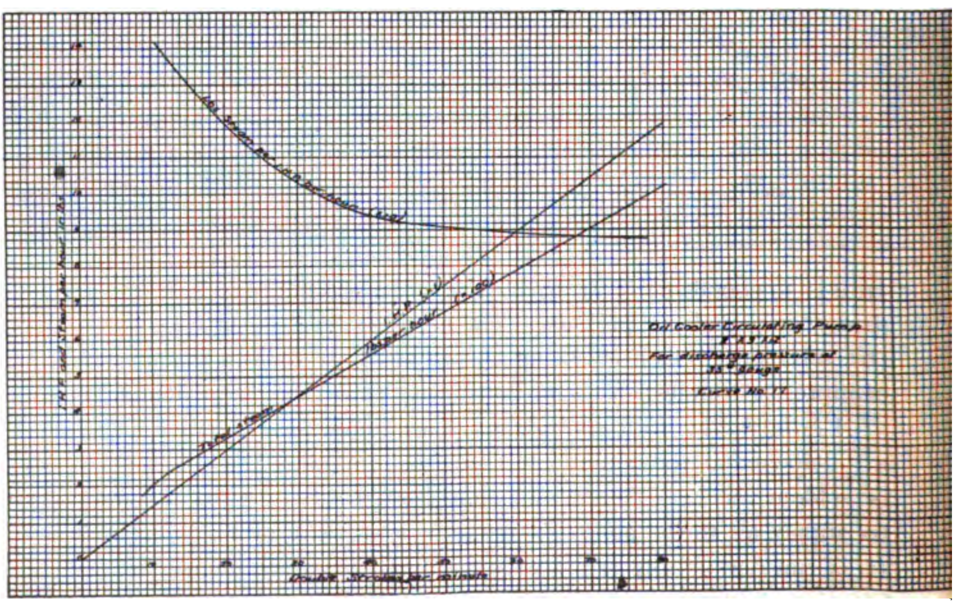
Torpedo Air Compressor.—These machines when used should run only at the rated capacity; under these conditions the water



rate is 30 pounds per I. H. P. per hour, at a speed of 350 R. P. M. and 3000 pounds air pressure. The machine develops 42 I. H. P., the mechanical efficiency being 65 per cent. It follows that one compressor running for one hour uses 1260 pounds of steam.

Westinghouse Air Compressor.—This compressor is rated for air delivered at 100 pounds pressure, but in practice this pressure is seldom used. A compressor runs from 12 to 13 hours a day to supply air to the galley oil range at a pressure of 15 pounds. It is run periodically at an air pressure of about 50 pounds for blowing the boiler tubes and occasionally at a pressure of 75 to


Lubricating Oil Pump
For discharge pressure
Curve No. 16
Double Strokes per minute


Oil Cooler Circulating Pump
For discharge pressure of
Curve No. 17
Double Strokes per minute

80 pounds for pneumatic tools. Under the above conditions the following steam consumptions obtain:

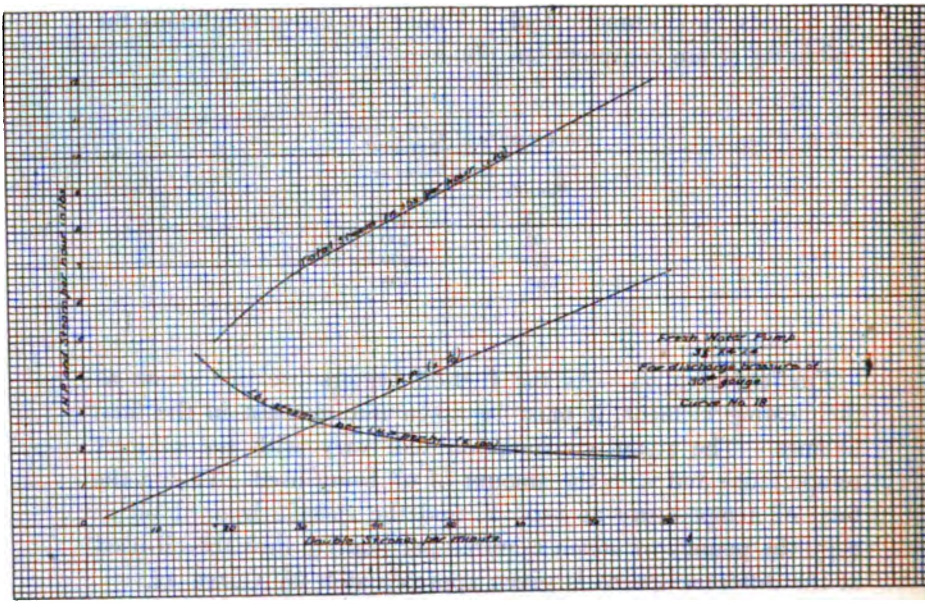
Air pressure	Total steam per hour
Pounds	
15	400
50	1200
80	1600
100	2500

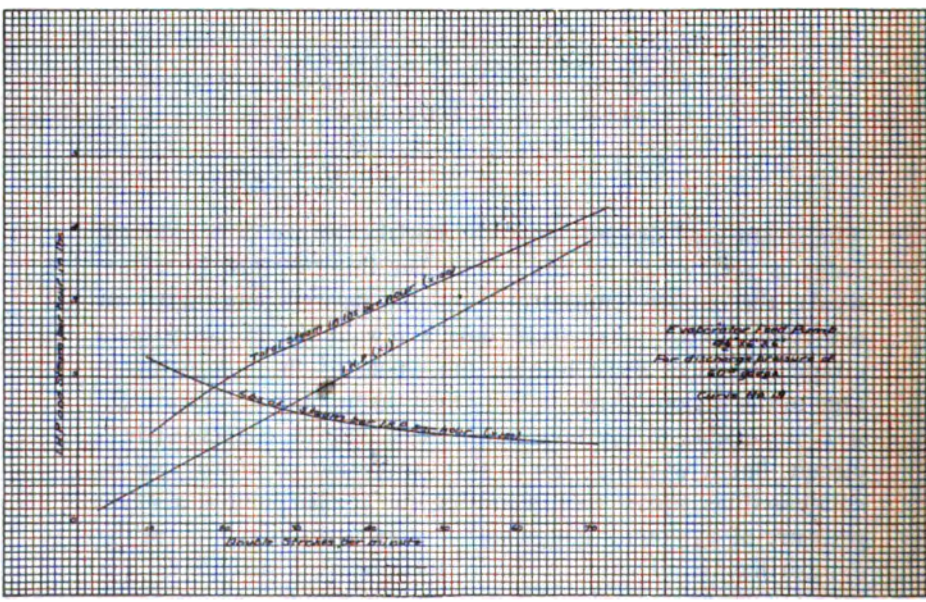
Fuel-Oil Heaters.—As the fuel-oil heaters use live steam as the heating element, it must be taken into account in the final balance. The steam consumption will vary with the oil-inlet temperature and with the amount of oil being used. Taking the final oil temperature at 150° F. and the specific heat of oil at 0.45, the pounds of steam required per hour to heat the oil used at the different speeds is given approximately by Curve 23.

Heating Systems.—The three heating systems have a total radiator surface as follows:

Circuit No. 1........	126.02 square feet
Circuit No. 2........	99.22 square feet
Circuit No. 3........	118.44 square feet
Total........	343.68 square feet

The steam used depends upon the initial pressure (the reducing valve is set for 25 pounds gauge, but this pressure is seldom used), the outside temperature, and the desired temperature of the compartment. As a rule, only a few of the radiators on a circuit are used, these heating the whole of the compartment. Due to the various elements that affect the amount of steam used, it is impossible to say how much steam will be condensed in a circuit, but a working rule is that 0.5 pound of steam will be condensed per square foot of heating surface per hour at a steam pressure of 25 pounds gauge and a temperature of 75° F. in the compartments. Therefore, for a total heating surface of 344 square feet, 172 pounds of steam would be used per hour under the above conditions.


Fresh Water Pump
For discharge pressure of
Curve No. 18
Double Strokes per minute


Evaporator Feed Pump
For discharge pressure of
Curve No. 19
Double Strokes per minute

Galley, Baths and Pantry.—The steam used in the galley, in heating wash water, in the pantry, and for heating the baths amounts to an appreciable figure in 24 hours. As an estimated figure to work with, 25 to 75 pounds of steam should be allowed per day.

IV. EXAMPLES OF ANALYSIS

Two examples of the application of the analysis are given below, the first for the vessel under way and the second for the vessel at anchor. In each example the first part consists of extracts of data that are available daily aboard ship, that is, without special data being taken. The second part consists of these data transferred to a form of analysis.

EXAMPLE 1.—Under way.

Extracts of data: Speed = 18 knots; R. P. M. = 206; displacement = 1400 tons; (standard R. P. M. = 187 for standard displacement of 1160 tons); feed-water temperature = 220° F.; oil for 24 hours = 15,000 gallons; water distilled = 10,500 gallons.

Auxiliaries	No.	Strokes or R. P. M.	Hours
F. D. blower	1	1050	24
Flushing pump	1	20	24
F. and B. pump	1	20	2
Oil-service pump	1	10	24
Oil-booster pump	1	7	24
Main feed pump	1	8	24
Lubricating pump	2	17	24
Main air pump	2	8	24
Evaporator feed pump	1	12	24
Distiller cir. pump	1	10	24
Fresh-water pump	1	45	24
Evaporators	..	Double effect.	24
West. air compressor	..	For galley.	12
Generator	1	258 K.W.H.	24.5
Steering engine	..	......	24

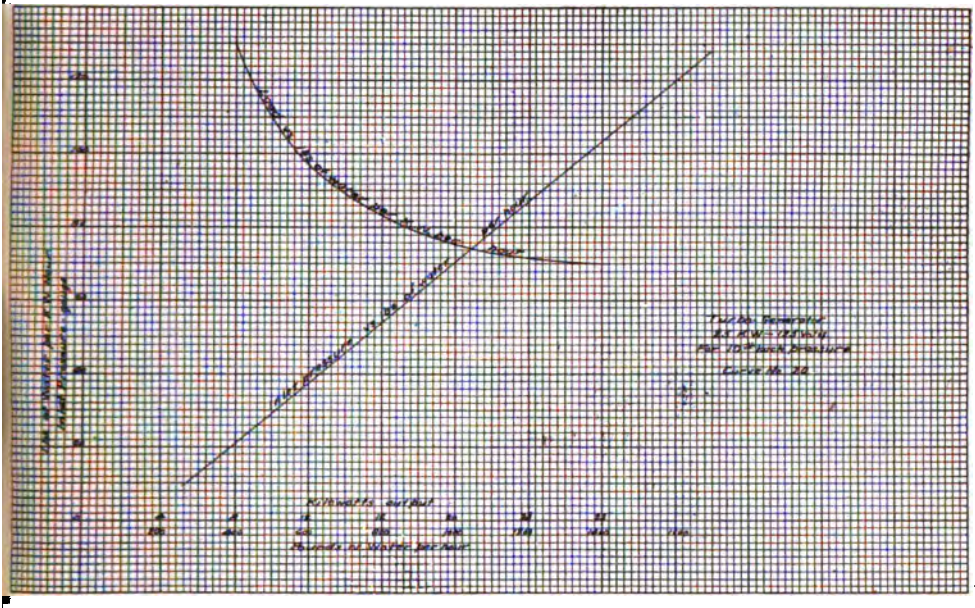
Analysis of performance—under way.

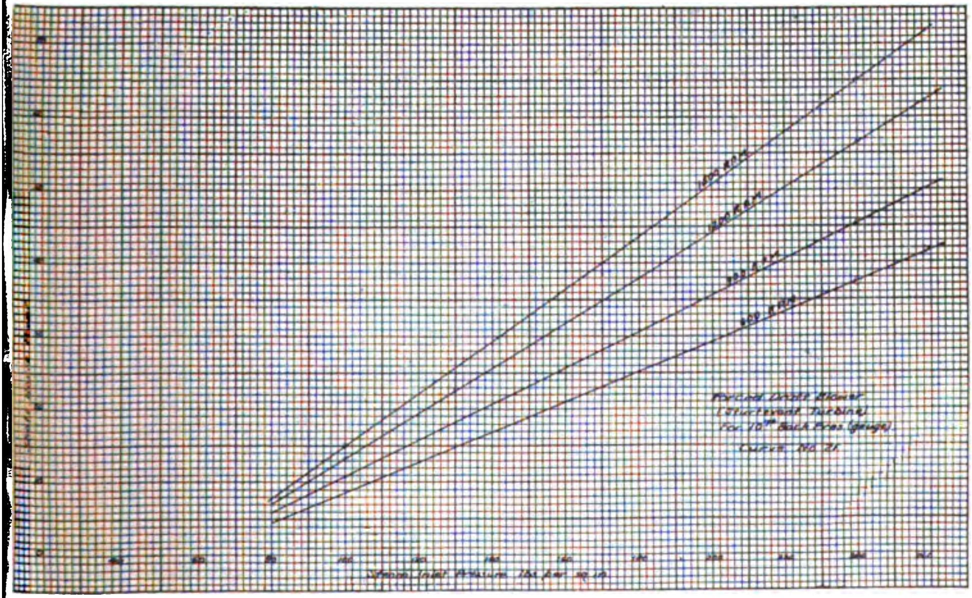
Machinery unit	H. P.	Water rate	Hours	Total steam
Main turbines	2700	18.0	24	1,166,400
1 main feed pump	2.1	63.5	24	32,004
1 F. and B. pump	..	(75)	2	150
1 flushing pump	..	(75)	24	1,800
1 evaporator feed pump	0.7	217.5	24	3,654
1 fresh-water pump	0.38	220	24	581
1 distiller cir. pump	1.9	101	24	4,606
1 lubricating oil pump	2.4	124	24	6,147
1 booster pump	0.3	240	24	1,728
1 service pump	1.4	158	24	5,308
2 main air pumps	6.3	180	24	53,568
1 air compressor	..	(400)	12	4,800
1 F. D. blower	51	87	24	212,876
1 steering engine	..	(200)	24	4,900
Water distilled, 10,500 gallons at 6.27 pounds steam per gallon				68,835
Current generated, 258 kilowatt-hours at 105.5 pounds steam per kilowatt-hour				26,976
(1) Total pounds steam used for 24 hours				1,591,530

Oil by account .... 15,000 gallons
Oil to galley .... 50 gallons
Oil burned .... 14,950 gallons
Rate of evaporation .... 118 pounds per gallon
Total equivalent evaporation .... 1,154,100 pounds
Factor of evaporation 1.045

(2) Total actual evaporation ...... 1,678,564 pounds

$$E=\frac{(1)}{(2)}=\frac{1,591,530}{1,678,564}=0.95 \text{ pound.}$$


Turbo Generator
For 10# back Pressure
Curve No. 20
Kilowatts output
Pounds of Water per hour


Forced Draft Blower
(Sturtevant Turbine)
For 10# Back Pres. (gauge)
Curve No. 21
Steam Inlet Pressure lbs. per sq. in.

EXAMPLE 2.—At anchor.

Extracts of data: Feed-water temperature = 210° F.; oil for 24 hours = 1658 gallons; water distilled = 3000 gallons; fire drill for 12 minutes, using 2 F. and B. pumps.

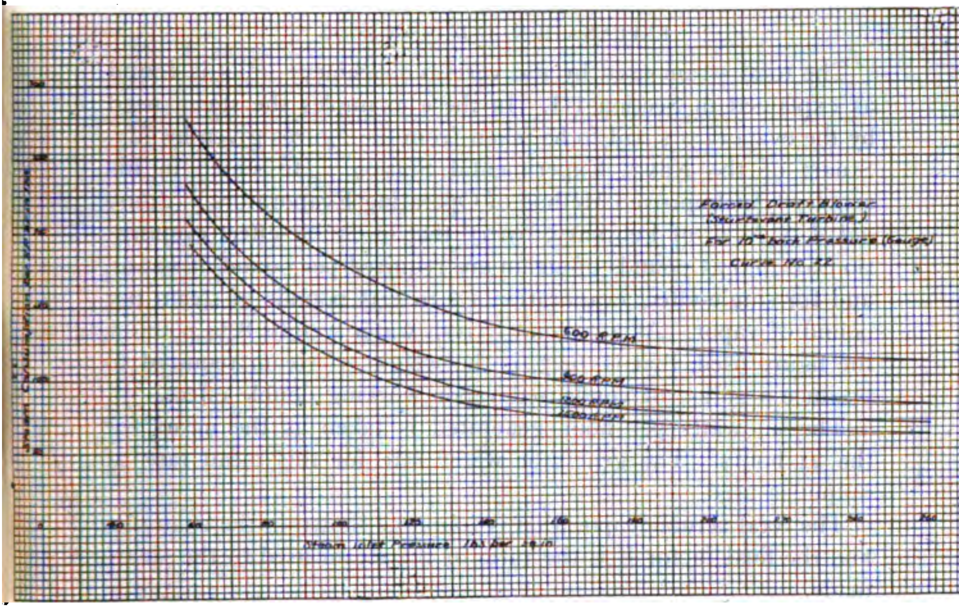
Auxiliaries	No.	Strokes or R. P. M.	Hours
Auxiliary and cir. pump	1	40	24
Flushing pump	1	35	24
F. and B. pump	1	35	1
F. D. blower	1	1,000	24
Service pump	1	7	24
Auxiliary feed pump	1	6	24
Evaporator feed pump	1	12	4.7
Distiller cir. pump	1	10	4.7
Fresh-water pump	1	40	4.7
Evaporators	..	Double effect.	4.7
Generator	1	192 K.W.H.	24.5

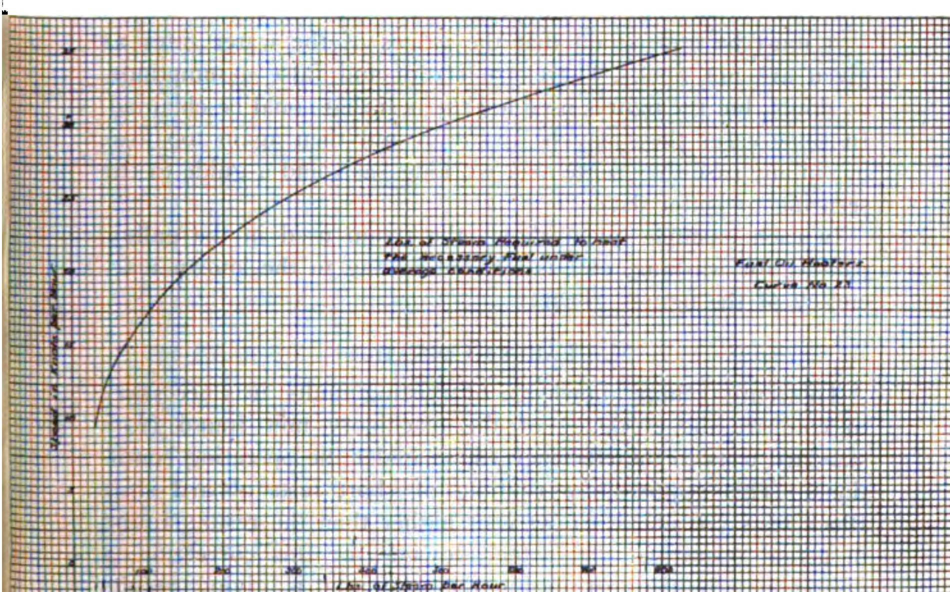
Analysis of performance—at anchor.

Machinery unit	H. P.	Water rate	Hours	Total steam
1 auxiliary feed pump	18	78	24	33,696
1 F. and B. pump	..	(75)	1	75
1 flushing pump	..	(75)	24	1,800
1 evaporator feed pump	0.65	215	4.7	657
1 fresh-water pump	0.34	240	4.7	384
1 distiller cir. pump	..	(75)	4.7	353
2 fire pumps	7 8	62	0.2	97
1 service pump	1	176	24	4,224
1 auxiliary air and cir. pump	2.25	130	24	7,020
1 F. D. blower	27	93	24	60,264
Water distilled, 3000 gallons at 6.27 pounds steam per gallon				18,810
Current generated, 192 kilowatt hours at 129 pounds steam per kilowatt hour				24,768
(1) Total pounds steam used for 24 hours				152,148

Oil by account	1,658 gallons
Oil to galley	50 gallons
Oil burned	1,608 gallons
Rate of evaporation	126 (estimated)
Total equivalent evaporation	202,608 pounds
Factor of evaporation	1.056
(2) Total actual evaporation	192,811 pounds

$$E = \frac{(1)}{(2)} = \frac{152,148}{192,811} = 0.79 \text{ pound.}$$


Forced Draft Blower
(Sturtevant Turbine)
For 10" back Pressure (Gauge)
Curve No. 22
600 R.P.M.
Steam Inlet Pressure lbs per sq.in.


Lbs. of Steam Required to heat
the necessary Fuel under
average conditions
Fuel Oil Heaters
Lbs. of Steam per Hour

EXPLANATION AND DISCUSSION

The total steam used by the various machinery units is found as explained in Section III. In these examples the steam used by the evaporators had to be taken from the figures given by Mr. Stuart of the Naval Experimental Station. He stated in his article, " An Improved Method of Operating Evaporators " (*Journal A. S. N. E.* of February, 1919), that in double-effect evaporation 0.6 to 0.75 pounds of steam are required per pound of vapor, and for single-effect evaporation 1.2 to 1.35 pounds of steam per pound of vapor. As a gallon of fresh water weighs 8.34 pounds, the figure used, that is, 6.27, is the weight of steam required to produce a gallon of condensed vapor working double effect.

The kilowatts per hour generated is taken as the mean for the 24 hours. The generator water rate for this mean rate of output is used.

The total actual evaporation is found as shown in the examples and the final factor E is the ratio of the steam used to the steam made.

The value of E for the first example may be too high, but it illustrates what should be approached.

It must be understood that the values of the water rates as given are not final. There are errors and false assumptions, no doubt, but the figures used are the best that could be obtained. In some cases they may be too high and then again too low, but in any case they serve as a working basis and a guide to the securing of better data.

In each example given above, the steam used in the galley, pantry, for washing, etc., is left out, owing to the known inaccuracy of the figures given.

V. FAULTY OPERATION

To secure definite knowledge of existing faults, it is necessary to compare the efficiency of the machinery unit found from standard tests to the efficiency found under the operating conditions. This requires the running of short tests aboard ship. Block tests run about 10 per cent higher than the results found in actual operation. If, after allowing for this correction, a discrepancy remains, it means that the unit is giving results that are below its best possible results by the amount of the difference between these two efficiencies.

VI. SUGGESTIONS

It is suggested that whenever possible such trials of the machinery units as can be handled on the ship should be carried out for the information of the operating personnel. As stated before in this article, the given values of the steam consumption for many of the machinery units are at the best only approximate. Much better values can be secured on board ship by some simple tests, using the formulæ of Section II. For instance, the steam condensed in the heating system can be found by collecting and weighing the discharged water from the traps. This applies to all other circuits that discharge through a trap, such as the fuel-oil heaters. Tests of a pump could be run by installing a special exhaust line through the auxiliary condenser from the pump being tested and running the remainder of the exhaust steam to a main condenser for the duration of the test, then by weighing or measuring the water from the auxiliary air-pump discharge the actual water rate can be found.

The regular application of this method of analysis to the results of the daily performance of the engineering plant will tend toward the better understanding of the plant by the personnel concerned. It will reveal the faults and points that require first attention when time is available for overhauling. Finally it will tend to result in increased economy; that is, the personnel will see how and where to get more out of the plant for the same amount of oil burned than formerly or, what amounts to the same thing, the desired performance will be secured for less oil burned.

REFERENCES USED

Mark's Handbook.

Power Test Code, A. S. M. E.

"The Economy Factor in Steam Power Plants," G. W. Hawkins.

"Power Plant Testing," Moyer.

Reports of Tests of Pumps by the United States Naval Experimental Station.

Data for Curves Nos. 3, 4 and 6 were secured from Lieutenant Fineman (C. C.), U. S. Navy; from reports of boiler tests held at the Philadelphia Fuel Oil Testing Plant; and from Admiral Dyson's article on "The Passing of the Direct Connected Turbine for the Propulsion of Ships" (*Journal A. S. N. E.*, August, 1919).

The actual pump data were furnished by the pump builders. The steaming data were checked with data secured from the U. S. S. *McCalla*.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

OUR FIRST NATIONAL SHIPPING POLICY

By JAMES P. BAXTER, 3D

A more cogent presentation of the case for government owned and operated merchant ships than Lieut. Commander K. C. McIntosh's brilliant article, "U. S. C. N.," in the October PROCEEDINGS, would be hard to imagine. Yet in the present temper of the press, public and Congress, all arguments for government ownership or operation of anything whatsoever, seem likely to fall on deaf ears. Confronted with the staggering deficits from railway operation, Congress has refused a longer trial of government-operated railroads, with the approval of the great majority of the press. Our war experience has given added strength to the American national sentiment for private ownership and private operation. With a score of yarns on his tongue about extravagance and waste in the construction of some cantonment, hospital, or shipyard, the average business man is perhaps more ready to draw inferences against government ownership than to draw the inescapable conclusion that twelfth-hour preparation means, inevitably, great cost in money and lives.

Whether the transition of our splendid new merchant fleet from public to private hands be made "as soon as practicable"—as provided by the Greene bill, which the House of Representatives passed by a vote of 240 to 8—or whether it be spread over a long period of years, the protection of American shipping against ruinous foreign competition is imperative. To expect private shipowners, handicapped by American conditions and denied protection, to compete successfully with foreigners enjoying direct or indirect government aid, is to disregard both the history of American navigation and the promptings of common sense.

Our first national shipping policy, steering clear of the rocks of ship subsidy, employed the Congressional power to regulate com-

merce so as to foster American shipping. This brilliantly successful policy ushered in the heyday of American navigation, when our ships "whitened every sea." A brief review of it will throw light on the provision of Senator Jones's pending bill which directs the President "without delay to take whatever steps are necessary to abrogate the provisions of all treaties of commerce that restrict our right to impose discriminating duties on imports carried in American ships."

Professor William Hill's admirable monograph, "The First Stages of the Tariff Policy of the United States,"[1] shows that protection to American shipping interests dates back to earliest colonial times. Previous to the Revolution, New Jersey, Delaware and Georgia were the only colonies which did not levy tonnage duties. Although these were clearly for revenue, "they were so framed that the colonial shipping interest secured a good degree of protection. In fact, there was no colony which did not exempt at least its own shipping from tonnage dues. The northern colonies all had reciprocity arrangements, by virtue of which the vessels of each entered the ports of the others free."[2] At first the colonists taxed British ships, but they were forced to desist when the merchants complained to the Crown.

As coin was exceedingly scarce in these early days, and munitions of war were much needed for conflicts with the French, Indians and Spanish, the impost on shipping, which was the earliest of any duties imposed by a colonial assembly, was at first made payable in powder. The Virginia act of 1632, whose rates were about the average imposed in the colonies, taxed each ship one hundred pounds of powder and ten iron shot for every one hundred tons burden.[3] "After money became more plentiful, the powder duties were commuted into cash payments ranging from sixpence to one or two shillings per ton, according to the amount of depreciation in the provincial currency."[4] Most colonies continued these duties until, in 1789, the regulation of commerce passed from the hands of the states to those of the Federal Government.

[1] American Economic Association's *Publications*, viii, no. 6, 1893.
[2] *Ibid.*, 20.
[3] *Ibid.*, 18.
[4] *Ibid.*, 19.

There were early examples of the policy, later famous, of attempting to coerce another government by commercial restrictions. By a retaliatory act passed in 1649, Massachusetts compelled Connecticut to repeal obnoxious tolls on goods carried down the river from Springfield. Virginia also sought to force Maryland to abandon tonnage dues on Virginia vessels.[5]

American navigation suffered severely under the policy of commercial restrictions adopted by the First Continental Congress on October 20, 1774. To force a change in British policy by pressure on her commercial interests, as at the time of the Stamp Act, the patriot "associators" bound themselves to enforce a stringent non-importation, non-exportation and non-consumption agreement, which soon laid bare the shelves of the importers and retailers. Hostilities told heavily on American shipping. In the years from 1776 to 1779, British privateers and ships of the squadrons of Howe and Gambier, took 570 vessels.[6] As the war progressed, however, trade increased. Yankee privateers brought in rich cargoes of prize goods, and daring skippers ran the blockade to trade with Holland, France, Spain and the West Indies. "By 1777, the storerooms began to fill up and after that year to the end of the conflict, necessities, luxuries, and even superfluities were abundant . . . . The war brought hardships to the Americans; but these had mostly disappeared by 1779 and the last years had been marked by speculation in business and extravagance in living. In 1783, the New Englanders and the dwellers in the Middle States were enjoying a degree of comfort unknown before 1775."[7] "The breakdown of the Continental currency in 1780 had been followed by an influx of specie which gave America more coin than she had ever before possessed."[8] Large sums of hard money were spent by the British and French fleets and armies, and coin was also imported from Havana and other foreign markets. With the coming of peace and independence, Americans naturally anticipated every blessing: boom times, high prices and expanding trade.

Their disillusionment was bitter. Independence left America outside the pale of Britain's navigation laws. All the profits re-

[5] *Ibid.*, 15.
[6] Channing, *History of the United States*, iii, 404.
[7] *Ibid.*, iii, 388, 389.
[8] Hill. *op. cit.*, 60.

sulting from direct trade with Europe, for which the colonists had long sighed, were outweighed by the losses inflicted by Britain's exclusive system. Her policy, the motives for which Mahan has luminously discussed in the first two chapters of *Sea Power in its Relations to the War of 1812,* gave to America some slight favors in the direct trade between the two countries, but excluded American ships from her West India colonies and from her remaining North American possessions. American salt fish and salted meats, butter and cheese, were shut out of the sugar islands even when carried in British bottoms. William Knox, who drafted the Order in Council of July 2, 1783,[9] boasted that he "carried it thro' against the opposition of Mr. Fox and Mr. Burke, and thereby saved the navigation and maritime importance of this country and strangled in the birth that of the United States."[10] This staggering blow closed a great market to New England fish, and cut off the most lucrative branch of American navigation. Despite some welcome relaxations of the exclusive systems of France and Spain, our shipowners suffered severely until they could develop new outlets for trade in the Baltic, the Mediterranean, and the Far East.

Immediately after the peace, a flood of British manufactures swept in upon the American merchants, swamped our infant industries, and drained our bountiful stock of specie. Professor Hill's figures for the trade with Great Britain in the three years from 1784 to 1786, show an adverse balance of over five million pounds sterling.[11] After a period of overtrading, the year 1785 witnessed severe business depression. With prices falling, manufactures at a standstill, navigation and the fisheries in dire straits, buoyant hope changed to bitter lamentation. Americans who suffered from the shortage of hard money, read with indignation of cargo after cargo of specie bound for England. In the summer of 1786, the bark *Mary Barnard,* freighted with the miscellaneous currency of the day, cleared from Boston for London, with "forty-six thousand one hundred and twenty-five dollars; twelve hundred and twenty-nine joes; one hundred and ten half-joes; eight hundred and six crowns; two thousand and eighty-seven guineas; eighty-five pistoles; two hundred and sixty-four dollars in silver;

[9] Printed in John Adams, *Works,* viii, 97 note.

[10] Channing, iii, 428.

[11] Hill, *op. cit.,* 67 note.

one moidore, and five hundred and fifty-six ounces of gold."[12] The hatred engendered by war was nursed by the conviction that the enemy's commercial policy was designed less to benefit herself than to cripple a rival. Our leading statesmen, who, except Hamilton, had been all free traders, yielded to the logic of events, and led a popular movement for retaliation and protection.

John Adams persistently and vehemently urged an American navigation act. In his letter transmitting to Secretary Livingston the hostile British decree of July 2, 1783, he declared that in protection and retaliation lay America's hope of maritime salvation.[13] To Jefferson he wrote, August 7, 1785: "We must do more than lay on alien duties. We must take measures by which the increase of shipping and seamen will be not only encouraged, but rendered inevitable."[14] In the same month, while arguing for a commercial treaty, he told Pitt that "the more Americans reflected upon the great advantages which they might derive from a navigation act, the more they would become attached to that system."[15] But his persistent efforts, during nearly three years at the Court of St. James, to put our commercial relations with Great Britain on a tolerable footing, came to naught. Jealousy and contempt blocked all negotiation. "Their direct object is not so much the increase of their own wealth, ships, or sailors, as the diminution of ours. A jealousy of our naval power is the true motive, the real passion which actuates them; they consider the United States as their rival, and the most dangerous rival they have in the world."[16] "But if an angel from heaven should declare to this nation [Great Britain], that our States will unite, retaliate, prohibit, or trade with France, they would not believe it. There is not one man in the nation who pretends to believe it; and, if he did, he would be treated with scorn."[17]

Until the impotent government of the Confederation gave place in 1789 to a more perfect Union, the British were safe in their unbelief. As early as 1778, the New Jersey legislature had declared that Congress ought to have the sole and exclusive power

[12] McMaster, *History of the People of the United States,* i, 294.
[13] John Adams, *Works,* viii, 97.
[14] *Ibid.,* 292.
[15] *Ibid.,* 305.
[16] *Ibid.,* 290
[17] *Ibid.,* 390.

of regulating the foreign trade of the states, suggesting at the same time that the customs revenue should be devoted to the creation and maintenance of a federal navy.[18] As this statesmanlike suggestion fell on deaf ears, the regulation of commerce was left in the hands of the thirteen separate State legislatures. The dire straits of American trade after the peace of 1783, however, made a national commercial policy imperative. April 30, 1784, Congress adopted the report of a committee composed of Jefferson, Gerry and three others, and recommended to the States that they amend the Articles of Confederation so as to vest Congress for fifteen years with the power to regulate commerce by a navigation act.[19] To amend the Articles required the unanimous vote of the states. Yet in 1786 it was found that Delaware, South Carolina and Georgia had passed no act upon the subject, and that the legislation of the other states presented a hopeless jumble of amendments, conditions and restrictions.[20] A letter from John Jay, then Secretary for Foreign Affairs, to John Adams, November 1, 1785, illuminates the sources of difficulty. "In a late report I have called the attention of Congress to this serious question, viz., whether the United States should withdraw their attention from the ocean and leave foreigners to fetch and carry for them, or whether it is more their interest to look forward to naval strength and maritime importance, and to take and persevere in the measures proper to attain it . . . . The Eastern and Middle States are generally for the latter system, and though the others do not openly aver their preferring the former, yet they are evidently inclined to it. Hence it is that the most of the leading men in Congress from that quarter [the South] do not only not promote measures for vesting Congress with power to regulate trade, but, as the common phrase is, throw cold water on all such ideas. Having few or no ships of their own, they are averse to such duties on foreign ones as will greatly advance the price of freight; nor do they seem much disposed to sacrifice any present proffer for the sake of their neighbors who have these and wish to have more."[21]

[18] G. T. Curtis, *Constitutional History of the United States*, i, 90.
[19] *Ibid.*, 192.
[20] *Ibid.*, 194.
[21] Jay, *Correspondence and Public Papers*, iii, 175.

The South, however, was by no means solid in opposition to a navigation act. An influential body of leaders, headed by Madison, took up the fight for maritime independence, and frequently, in the next few years, outdistanced even the representatives of New England in zeal for our national shipping. We catch a glimpse of Virginians of the opposite extreme in a letter from Madison to Jefferson, January 22, 1786, describing a recent debate in the State legislature. "The Speaker [Benjamin Harrison], Thurston, and Corbin . . . . were bitter and illiberal against Congress and the Northern States beyond example. Thurston considered it as problematical, whether it would not be better to encourage the British than the Eastern marine. Braxton and Smith were in the same sentiments, but absent at this crisis of the question."[22]

Confronted with the failure to provide for federal regulation of commerce, the states attacked their problems single-handed. New York, in 1784, imposed double duties on goods imported in British vessels, whether brought directly or through other states, thus seeking to compel her neighbors to discriminate against British shipping. New Hampshire levied treble tonnage taxes on foreign ships and double duties on goods brought in them. Rhode Island placed treble duties on goods imported in British bottoms, and in 1786 provided that no American goods should enter the state in British ships. Massachusetts supplemented her rigorous protective tariffs with an extraordinary tonnage duty on foreign vessels. Both Maryland and Virginia taxed British ships one dollar per ton, discriminated in favor of the French and Dutch, and admitted American ships free. These two states and the Carolinas had discriminating tariff duties as well as tonnage taxes. In the same manner Pennsylvania protected American shipping. Her discriminating duties on teas, which were the model for similar provisions in the first national tariff act of 1789, gave the impetus to the direct trade with the Far East, which was such a spectacular feature of early American commerce. The discriminating duties of all the states averaged nearly sixty cents per ton.[23]

[22] Madison, *Writings* (Hunt edition), ii, 218.

[23] For the varied state legislation, see: E. R. Johnson and others, *History of Domestic and Foreign Commerce of the United States*, i, 139, 172; W. W. Bates, *American Navigation*, 37, 47.

But the administrative systems of the states were so lax, their interests so divergent and their jealousies so unrestrained, that the system of state regulation broke down.[24] In Madison's letter to Jefferson, above cited, we read: "The local efforts to counteract the policy of G. B., instead of succeeding, have in every instance recoiled more or less on the states which ventured on the trial . . . . Discord [has been] produced between several States by rival and adverse regulations. The evil had proceeded so far between Connecticut and Massts. that the former laid heavier duties on imports from the latter than from G. B."

This breakdown of state regulation, and lack of power in the federal head, were of the greatest importance in producing the new Constitution and stronger government. During the first debates of the First Congress, Fisher Ames of Massachusetts declared: "I conceive, sir, that the present Constitution was dictated by commercial necessity more than any other cause. The want of an efficient government to secure the manufacturing interests, and to advance our commerce, was long seen by men of judgment, and pointed out by patriots solicitous to promote our general welfare."[25] In his luminous history of our Constitution, George Ticknor Curtis remarked: "Let the reader consider the interests of commerce, in their widest relations with all that they comprehend—the interests of the merchant, the artisan, and the tiller of the soil being alike involved—as the chief purpose of the new government given to this Union; let him contemplate this as the central object around which are arranged almost all the great provisions of the Constitution of the United States . . . . That such a code of civil government should have sprung from the necessities of commerce is surely one of the triumphs of modern civilization."[26]

Sectional interests clashed in the Constitutional Convention. The report of the Committee of Detail, delivered August 6, denied Congress the power to pass a navigation act without the assent of two thirds of the members present in each House, or to prohibit or tax the migration or importation of slaves.[27] When agree-

[24] Channing, *op. cit.*, iii, 466; Curtis, *op. cit.*, i, 195.

[25] *Annals of Congress, 1 Cong.*, 221.

[26] Curtis, *op. cit.*, 515.

[27] Madison, *Journal of the Constitutional Convention, Writings*, iv, 100.

ment on these provisions, both of which were in the Southern interest, seemed impossible, they were referred, on August 22, to a special committee of eleven, appointed to "form a bargain among the Northern and Southern States."[28] The resulting compromise gave Congress the power to pass a navigation act by a bare majority, and provided that: "The Migration or Importation of such Persons as any of the States now existing shall think proper to admit, shall not be prohibited by the Congress prior to the Year one thousand eight hundred and eight, but a Tax or duty may be imposed on such Importation, not exceeding ten dollars for each Person."[29] Elimination of the two-thirds requirement had evoked a sharp debate. Clymer, of Pennsylvania, asserted that the Northern and Middle States would be ruined unless they were given a navigation act. Gouverneur Morris declared that: "Preferences to American ships will multiply them, till they can carry the Southern produce cheaper than it is now carried. A navy was essential to security, particularly of the Southern States, and can only be had by a navigation act encouraging American bottoms and seamen." George Mason, of Virginia, protested. "The Southern States are the *minority* in both Houses. Is it to be expected that they will deliver themselves bound hand and foot to the Eastern States, and enable them to exclaim, in the words of Cromwell on a certain occasion, 'the Lord hath delivered them into our hands'?" Unreconciled to the omission of the two-thirds requirement, and to other provisions, Mason and his colleague, Edmund Randolph, refused to sign the Constitution.

The brilliantly successful system of shipping protection established by the First Congress through the Tariff and Tonnage Acts of July 4 and July 20, 1789,[30] comprised four distinct features: (1) Discriminating tariff duties on teas and other Asiatic goods gave a great stimulus to the direct trade with the Far East. (2) A discount of 10 per cent of the customs duties on all goods imported in American bottoms made our ships the preferred vessels for carrying to the United States, and helped to provide a profitable return cargo for the American shipowner. (3) Tonnage duties on foreign vessels were more than eight times heavier than on American vessels. (4) The coastwise trade was prac-

[28] *Ibid.*, 271-273.

[29] *Ibid.*, 292, 303-306, 326-332, 469, 491.

[30] *Annals of Congress, 1 Cong.*, 2129, 2132.

tically reserved to American bottoms. To round out the system by extending further protection to American shipbuilding, Congress passed our first Registry Act, September 1, 1789.[31]

No sooner had the members of the House of Representatives assembled, taken the oath, and resolved themselves into a Committee of the Whole, than Madison rose to introduce the tariff and tonnage measures.[32] Except for an act to regulate the time and manner of administering certain oaths, they were the first laws on our statute book. For knowledge of the Congressional opinions, we have to rely chiefly on the House debates, because until 1794 the Legislative as well as the Executive proceedings of the Senate took place behind closed doors. During the discussions in the House, were read petitions from the shipwrights of Charleston, Baltimore and Philadelphia, stating their distress and praying for a navigation act.[33] Fitzsimmons, of Pennsylvania, introduced the discriminating duties on teas, remarking that the trade to India, favored by the Pennsylvania state tariff, already "has had a very happy effect in favor of our inhabitants, by reducing commodities brought from thence to one-half of their former price, and yet a sufficient profit is left to enable those concerned to carry it on with advantage."[34] His proposals, which the House adopted after a brief discussion, were much improved by the Senate. Teas paid a low duty if imported direct from the Orient in American bottoms, a medium duty if brought in American ships from Europe, and a high duty if imported in foreign vessels. Other Oriental goods, when brought in foreign ships, were taxed nearly twice as much as if imported in American bottoms. These provisions, in practice, both increased the trade with the Far East and confined it to American vessels.[35] The important clause allowing a drawback of 10 per cent of the duty payable on all goods imported in American bottoms, was suggested by William Smith, a Baltimore merchant, and was carried by a vote of 30 to 16.[36] The tonnage dues were: on American bottoms, six cents per ton; "on all ships or vessels hereafter built in the United States, belonging wholly, or in part, to subjects of foreign Powers,"

[31] *Ibid.*, 2161.
[32] *Ibid.*, 102.
[33] *Ibid.*, 123, 233, 409.
[34] *Ibid.*, 169.
[35] Johnson and others, *op. cit.*, ii, 337.
[36] *Annals of Congress, 1 Cong.*, 343.

thirty cents per ton; on all other ships or vessels, fifty cents per ton.[37] The Senate rejected the provision in the House bill confining by law our coastwise trade to American bottoms; but achieved the same end by a prohibitory tonnage tax. American ships employed in the coasting trade or in the fisheries paid six cents per ton once a year, while every foreign vessel had to pay fifty cents per ton for each entry into an American port.[38]

Opposition to the tonnage duties was confined to Tucker, Burke and Smith of South Carolina, Jackson of Georgia, and Bland of Virginia. Urging low rates, they insisted that the duties would fall on the American producer instead of the foreign consumer. Tucker protested that the tax would be exclusively borne by a few Southern States.[39] Smith declared: "I would as soon be persuaded to throw myself out of a two-story window, as to believe a high tonnage duty was favorable to South Carolina."[40] Burke was sure that Carolinians believed a high tonnage duty a great evil, but later added: "I believe the citizens [of the South] look with indignation at the power which foreigners have over their commerce. So far from being jealous of the Eastern States, they look forward to some future day when their navigation will be secured to that part of the Union."[41]

Fitzsimmons replied that a tonnage duty, in almost every instance, was paid by the consumer. He advocated a navy to safeguard our neutrality. "The United States can have no commerce without a navy . . . . but if we increase our navigation, and add to the number of our seamen, we shall become respectable, and may be able to pursue our obvious interest in supplying the parties engaged [in war] with the superabundance of our soil, and enable us to stipulate for reciprocal advantages in the West India commerce. If we do not now, while we have time, improve our situation, two or three British frigates may prevent us from gathering these benefits [of neutral trade] hereafter."[42]

Madison led the protectionists with several brilliant speeches. He declared that protection of our shipping would benefit our farmers. "By encouraging the means of transporting our productions with facility, we encourage the raising them."[43] "If it is expedient for America to have vessels employed in commerce at

[37] *Ibid.*, 2132. [38] *Ibid.*, 290, 608, 2132. [39] *Ibid.*, 179. [40] *Ibid.*, 286.
[41] *Ibid.*, 181, 256. [42] *Ibid.*, 241, 278. [43] *Ibid.*, 112.

all, it will be proper that she have enough to answer all the purposes intended; to form a school for seamen, to lay the foundation of a navy, and to be able to support itself against the interference of foreigners . . . . I consider that an acquisition of maritime strength is essential to this country; if ever we are so unfortunate as to be engaged in war, what but this can defend our towns and cities upon the sea-coast? Or what but this can enable us to repel an invading enemy?"[44] "The arguments offered against the measure are founded on a maxim of impolicy. It is stated, that . . . . we ought not to enter into regulations that will increase the price of freight. The plain meaning of which I take to be, let us employ those vessels that will do our business cheapest . . . . I admit, that laying fifty cents on foreign vessels, and but six on our own, is a regulation by which the owners of American shipping will put a considerable part of the difference into their pockets. This, sir, I consider as a sacrifice of interest to policy; the sacrifice is but small, but I should not contend for it, if we did not stand in need of maritime improvements . . . . But we have maritime dangers to guard against, and we can be secured from them no other way than by having a navy and seamen of our own; these can only be obtained by giving a preference . . . . This tax, therefore, may prevent the horror of a war, and secure to us that respect and attention which we merit."[45]

The storm center of debate was Madison's proposal to levy on ships of nations that had formed commercial treaties with us—France, Holland, Sweden and Prussia—a tonnage duty lower than that on ships of Great Britain and other nations not in treaty. He urged that popular sentiment strongly favored a discrimination; that France, our ally, should be favored; that to put Great Britain at once on the footing of the most favored nation was highly impolitic. He declared that as long as we repaid Britain's ill treatment by tamely permitting her to enjoy on her own harsh terms the bulk of our trade, we could not expect her to relax her hostile restrictions; that "If we give everything equally to those who have or have not formed treaties, surely we do not furnish to them any motive for courting our connexion." He feared no British reprisals, for we could, if necessary, ruin their West India islands by refusing them our foodstuffs.[46]

[44] *Ibid.*, 189. [45] *Ibid.*, 237. [46] *Ibid.*, 181, 204, 237-240.

Opposition to discrimination was skilfully led by Lawrence of New York, supported by Benson of New York, and Sherman and Wadsworth of Connecticut. Lawrence urged that France had done little or nothing for our commerce; that our trade with England, even though restricted, was profitable; and that it would be folly to antagonize her and invite reprisals. Britain could easily ruin us if she chose, for "we are, as it were, the creatures of yesterday, unable to stand such competition."[47] His appeals to prudence, however, availed nothing in the House, which, by a vote of about 40 to 9, agreed to tax vessels of treaty nations thirty cents per ton, as against fifty cents on vessels of nations not in treaty.[48] Madison wrote Jefferson, May 9, that the opposition to discrimination, "tho. patronized by some respectable names is chiefly abetted by the spirit of this City [New York], which is steeped in Anglicism."[49]

The Senate, however, rejected the proposed discrimination, and remained inflexible.[50] Despite Madison's appeals, the House finally yielded, by a vote of 31 to 19.[51] The Senate majority preferred conciliation towards Great Britain,[52] and undoubtedly feared reprisals; but Madison was probably right in his assertion that "A considerable number, both in the Senate and H. of Reps. objected to the measure as defective in energy, rather than as wrong in its principle."[53] While Madison may not have overestimated the dependence of the British sugar islands on American supplies, it seems probable that he failed adequately to gauge the British temper and the dangers of commercial warfare to our empty treasury.[54] The British ministry would have hesitated not a moment to sacrifice the prosperity of colonial planters in order to protect the special privileges of British shipowners.[55]

[47] *Ibid.*, 183-185, 203, 234-236.

[48] *Ibid.*, 290; Madison, *Writings*, v, 361 note.

[49] Madison, *Writings*, v, 355 note.

[50] Fisher Ames, *Works*, i, 57.

[51] *Annals of Congress, 1 Cong.*, 607-610, 615-619.

[52] Washington to G. Morris, Oct. 13, 1789, *American State Papers, Foreign Relations*, i, 122.

[53] Madison, *Writings*, v, 433. See also: *Ibid.*, 415 note; Ames, *Works*, i, 60; *Annals of Congress, 1 Cong.*, 46, 57, 588-592, 608-610, 615-619; Schouler, *History of the United States*, i, 102.

[54] Johnson and others, *op. cit.*, ii, 7.

[55] Mahan, *Sea Power in its Relation to the War of 1812*, i, chs. i, ii.

As for America, nearly two-thirds of our foreign trade[56] was with Great Britain; on this trade depended our national revenue; and on the basis of that revenue Hamilton was about to erect a splendid structure of national credit, the salvation of the Republic. Fisher Ames wrote to his friend Minot: "The Senate, God bless them, as if designated by Providence to keep rash and frolicsome brats out of the fire, have demolished the absurd, impolitic, mad discrimination of foreigners in alliance from other foreigners."[57]

Of the effects of our first national shipping policy, Adam Seybert, a contemporary writer, declared: "Our discriminations operated powerfully in favor of our shipping . . . . All foreign nations were affected by the system we had adopted; it seemed to operate like magic in favor of ship-owners in the United States."[58] Mahan states that "After one year of the discriminating tonnage dues laid by the national Congress, the American tonnage entering home ports from Great Britain had risen, from the 26,564 average of the three years, 1787 to 1789, ascertained by the British committee, to 43,580."[59] Dr. G. G. Huebner, of the University of Pennsylvania, has compiled a table, which shows that the proportion in value of our foreign trade carried in American bottoms, rose from 40.5 per cent in 1790 to 79.5 per cent in 1793, and 90 per cent two years later; but he states that the returns for 1789 to 1793 were incomplete.[60] American tonnage in foreign trade entering home ports, rose from 354,767 in 1790 to 414,679 in 1792, while British tonnage entering our ports fell from 216,914 to 206,065. Owing to the added stimulus of the European war, the corresponding figures for 1796 were: American, 675,046; British, 19,669.[61] American shipowners were enjoying the extraordinary prosperity which filled our seaport towns with the fine old houses so familiar to New Englanders.

If our first national shipping policy achieved such admirable results in expanding our merchant marine and enriching our nation, is it vain to hope that we can learn something from it to-day?

[56] Johnson and others, *op. cit.*, ii, 6.

[57] Ames, *Works*, i, 45.

[58] Seybert, *Statistical Annals*, 294. Cited in Johnson and others, *op. cit.*, ii, 27.

[59] Mahan, *op. cit.*, i, 80.

[60] Johnson and others, *op. cit.*, ii, 28.

[61] *American State Papers, Commerce and Navigation*, i, 389.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

REPORT AND RECOMMENDATIONS OF A BOARD APPOINTED BY THE BUREAU OF NAVIGATION REGARDING THE INSTRUCTION AND TRAINING OF LINE OFFICERS[1]

OUTLINE OF BOARD REPORT

1. Scheme of report.
2. Scope of consideration.

PART I. INSTRUCTION (TRAINING) OF THE LINE OFFICER

3. Manifold requirements of naval profession.
4. Periodical instruction indispensable to efficiency.
5. Four phases of naval career.
6. Instruction (training) also in four phases.
7. Duration and time of training periods.
8. First period—the Naval Academy.
9. Second period—general line course.
10. Instruction and training for the duties of command.
11. Third period—junior War College course.
12. Fourth period—senior War College course.
13. Provision of necessary arrangements (time and numbers) for instruction and training.

PART II. SPECIALIZATION

14. Universal specialization required.
15. The "exchange" principle involved.
16. Specialists defined (delimited).
17. Specialists in design and production of material.
18. Specialists in manipulation of material.
19. Specialists for special duty only.
20. Other specialties pertaining to line requirements.
21. The officers of the staff corps (and Marine Corps).
22. Temporary exceptions from general line course.

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[1] This report is published by permission of the Navy Department for the information of the service. The report of the Board has been approved, but the shortage of officers will not permit the recommendations to be carried into effect at present.

PART III. PRACTICAL CONSIDERATION

Reference: (a) Bunav. let. No. 8039-198, 16 Oct., 1919.
(b) P. G. Dept. Nav. Acad. Let. No. 159, 27 Aug., 1919. (Enc. "A.")
(c) Bunav. 2d End. No. 8039-198, 10 Sept., 1919.
(d) Supt. War College 3d End. No. 733-2-2, 17 Sept., 1919.

1. The report of the Board is presented in two papers in order that on the one hand the "findings" of the Board may be readily comprehended (Summary), and on the other hand, that the considerations leading to the "findings" may be available for examination (Supplement). This paper constitutes the "Summary," whose paragraph numbering corresponds to that of the "Supplément."

2. In the scope of consideration entered into by the Board it has been found necessary to include the entire career of a naval officer, from midshipman to admiral; consideration is limited to the line officer, except where expressly stated otherwise. It is noteworthy that existing arrangements provide only for the special instruction of younger officers in matters relating to the design and production of material.

PART I. INSTRUCTION OF THE LINE OFFICER

3. The necessity for instruction (training) is deemed apparent from a review of the varied subjects of which a working knowledge is required by the efficient naval officer; subjects which embrace a multiplicity of arts, industries and sciences, whose advance is continuous and progressive.

4. Inasmuch as it is obviously impracticable and impossible to equip the officer for the whole period of his service during his initial instruction (Naval Academy) it becomes necessary to arrange and to provide for his further instruction and training at recurring periods.

5. The career of the commissioned naval officer from ensign to admiral is found to be comprised in four general phases, increasing progressively in responsibility and authority as his experience

and ability warrant, measure of which is clearly indicated by the established graded advance in rank.

TYPE CASES

Phase I. Inferior subordinate—division officer.
Phase II. Superior subordinate—head of department.
Phase III. Commanding officer—command of single ship.
Phase IV. Flag officer—command of group of ships.

6. Four periods of instruction (training) are found necessary, to be so distributed through the naval officer's career as to make it the general rule that an instruction and training period precedes the employment in an advanced phase of usefulness (as indicated in paragraph 5 above).

The *four* instruction and training periods are:

I. The Naval Academy.
II. The general line course.
III. The junior War College course.
IV. The senior War College course.

So that as

(a) The Naval Academy (initial instruction period) prepares for the earliest and lowest phase—inferior subordinate, so will—

(b) The general line course (second instruction period) prepare for the second phase—superior subordinate—and

(c) The junior War College course (third instruction period) prepare for the third phase—commanding officer—and

(d) The senior War College course (fourth instruction period) prepare for the fourth and highest phase—flag officer.

7. The length of time and the point in the service at which the instruction (training) periods should take place are found to be:

(a) Naval Academy—four years—preliminary and preparatory to commission, in readiness for first phase of usefulness—inferior subordinate.

(b) General line course—one year—between five and ten years commissioning (preferably after five years, general service) in readiness for second phase of usefulness—superior subordinate.

(c) Junior War College course—one year—between tenth and twentieth year of commissioned service (preferably while in the

grade of lieutenant commander) in readiness for third phase of usefulness—commanding officer.

(d) Senior War College course—one year—after twentieth year of commissioned service (preferably while in the grade of captain), in readiness for final phase of career—flag officer.

8. *Naval Academy.*—The purpose of the instruction and training of midshipmen at the Naval Academy is to graduate officers properly equipped to continue the study and begin the practice of their profession as "inferior subordinates."

9. *General Line Course.*—The function of the general line course is the unification and confirmation of previous instruction and experience of officers, and their progressive instruction in readiness for duties of the next higher order, *i. e.*, "superior subordinates." The curriculum proposed in Reference (b) is recommended for immediate adoption.

10. *Instruction and training for the duties of command* is essential to efficient carrying out of war operations in order that the whole body of commanding officers and of unit commanders and their staffs may have common conceptions of basic considerations and of practical methods which are requisite for the thorough cooperation and co-ordination which make "unity of action" a real and compelling factor in the attainment of victory. This instruction is best given in two periods: the first, before attaining command rank and the second before attaining flag rank.

12. *Senior War College Course.*—The purpose of this course is to unify and confirm all previous instruction and experience in the advanced elements of the profession, and to insure an adequate knowledge of the principles which govern the operation and administration of forces and fleets, in readiness for prospective employment as flag officer. This period of instruction is intended to provide for thorough training in the exercise of the command of fleets and fleet units.

13. It is considered to be to the highest interest of the Government not only to provide for the above recommended instruction (training) but to require it, in order that the naval service may be maintained at the highest possible degree of efficiency. The necessary arrangements should provide for the inclusion of an additional percentage to the personnel estimates.

PART II. SPECIALIZATION

14. The requirements of the naval profession are found to be such that provision must not only be made (a) for the progressive education of officers at recurring periods as recommended above, but also (b) for the specialization of all officers in at least one branch of the profession, in order to insure that full knowledge and use may be made of the constant progress in all of the arts, industries, and sciences, which can in any way contribute to the advancement of efficiency in naval warfare in any of its manifold aspects and requirements. Some of this specialization can be accomplished by instruction and some of it by suitable assignments to duty.

15. Since no officer can be equally proficient in all branches of the profession but should have as much knowledge of all as possible, it is necessary for officers to specialize, not only in order that full use may be made of development in individual fields but also that profitable " exchange " may be made among the body of officers composing the service, to the end that all may be acquainted to the fullest practicable extent with the advances and developments affecting the profession.

16. Every officer, while expert in certain fundamental elements of the profession, should be a specialist in at least one particular branch. Specialization divides into five general classes:

(a) Line officers who specialize in the design and production of material.

(b) Line officers who specialize in the manipulation (skill in use and operation) of material.

(c) Line officers for special duty only.

(d) Line officers who specialize in the requirements other than those which deal directly with material.

(e) The several staff corps and the Marine Corps.

17. *Specialists in Design and Production of Material.*—Certain line officers should be selected to be specially instructed and trained in readiness to fill the service needs for experts in the design and production of material. These specialists are those officers who are, as at present, specially instructed in the existing post-graduate technical courses. The majority of them, after performance of duty ashore and afloat in their several specialized lines, continue

in the line of the navy but some few elect "special duty only" as mentioned in paragraph 19 below.

18. *Specialists in Manipulation of Material.*—Certain line officers should be specially instructed to fill the service needs for expert and concentrated attention on the development of manipulation (skill in use and operations) of material. While all line officers must attain a degree of proficiency in these matters, only the attention of "specialists" can be expected to insure the highest possible improvements and developments.

19. *Specialists for Special Duty Only.*—Specialists of this class should not be selected until they have demonstrated their proficiency in the elementary stages of specialization and in the performance of duty in the specialty. The existing law permits this selection only after reaching the grade of lieutenant commander, which arrangement is considered satisfactory.

20. *Requirements Other Than Those Pertaining Directly to Material.*—Line officers who become experts, whether on account of education, instruction, employment or attention, in the theory and practice of leadership, management of personnel, the conduct of naval operations, organization and administration afloat and ashore, seamanship and navigation, etc.

21. *The Staff Corps and Marine Corps:*—

(a) The staff corps divides into two general classes.

(1) Combatant: naval constructors, supply officers, civil engineers.

(2) Non-combatant: medical and dental officers, and chaplains.

(b) So far as practicable, all officers of the combatant staff corps should, for the purpose of unified interests, be graduates of the Naval Academy.

(c) Officers of the non-combatant staff corps should receive, on entry into the service, some instruction in leadership, military character, etc., which can well be included in the curriculum of the medical school.

(d) Officers who are to be naval constructors and civil engineers should serve at least two years at sea and should preferably complete the general line course before beginning their technical education (see par. 22, following), in order that their future

specialized work may include practical comprehension of the relations between such work and the requirements afloat and ashore.

(e) Officers entering the Supply Corps and Marine Corps should, upon entry in these corps, receive a course of special instruction in suitable "schools of application" for their respective lines of work. Selected officers of the Supply Corps and of the Marine Corps should attend the junior and senior War College courses. Selected officers of the Marine Corps should attend the several Army schools which provide advanced education for operations on shore.

22. *Temporary Exceptions from General Line Course.*—While the satisfactory completion of the general line course requirement is considered indispensable for all line officers and for naval constructors and civil engineers, it is considered feasible to dispense with this requirement for officers who are selected to be specially educated by means of the existing post-graduate technical courses until such time as the existing shortage of officers becomes materially reduced.

PART III. PRACTICAL CONSIDERATIONS

23. *Initiation of Recommendations.*—While realizing that present service conditions may not permit the carrying into full effect of these recommendations immediately, the Board strongly urges the necessity for the adoption of a well-considered plan in order that matters may be shaped towards the general bringing of the definite plan into full force and effect, and considers it essential to the efficiency of the service that beginnings be made in regard to both instruction (training) and specialization.

24. *General Graph of Employment.*—Ensign to Commander—There appears herewith as Enclosure a graph indicating the general lines of employment in the career of an officer from ensign to commander. Endeavor has been made to generalize employment as much as practicable and to show, in addition to the three general instruction periods involved (Naval Academy, General Line Course, Junior War College Course), how specialization may be carried into effect, whether by instruction or employment, or both.

25. Coordination among and between the several agencies of instruction is required in order to ensure systematic progression and unity to the training scheme regarded as a whole. For this purpose a permanent Supervisory Board should be created.

SUPPLEMENT

1. *Supplement to Report of Board on Instruction and Training of Line Officers.*—This paper is the "Supplement" to the report of the Board. The paragraphs are numbered to correspond to the similar parts and paragraphs of the "Summary" of findings.

2. *Scope of Consideration Undertaken by Board.*—The scope of consideration by the Board is based on the phrase "any other recommendations pertinent thereto" in Reference (a) and on paragraph 4 of Reference (c), namely, that the proposed post-graduate general line course cannot properly be dealt with except as a component part of a whole scheme for the instruction and training of naval officers during their entire careers, from midshipman to admiral, both inclusive.

PART I. INSTRUCTION OF THE LINE OFFICER

3. *Reasons for Instruction of Commissioned Officers.*—

(a) The present advanced state of civilization includes great development in every branch of the arts, industry and science, so great that keeping abreast of developments in one branch of art, industry or science is practically a life-work. Development is proceeding at an ever-accelerating rate and the complication of activities is increasing continuously.

(b) The requirements of the naval profession have an even broader scope than indicated above. The naval officer must be prepared to combine all these technical elements into an organized and unified force in such a way as to have a maximum effect when exerted against an enemy. The navy as a whole must be operated as a unit, which requires high proficiency in such matters as organization, administration and management.

(c) The intimate dependence of efficiency of material upon efficiency of personnel imposes a further major requirement upon the officer. He should be an expert in the art of leading men, which

necessitates a high degree of knowledge of the underlying principles, if effective and united action is to be obtained in the face of the difficulties confronting naval forces in war.

(d) The opinion has been generally held, in the navy, that the only way to learn things is to do them. This opinion has had much truth and fact to justify it, but this idea has been undergoing a marked transformation in recent years. It is becoming realized more and more that although one cannot learn to do a thing by merely being told how it is done, such previous knowledge greatly facilitates learning how to do it when practical work is started. This knowledge affords its possessor a strong foundation, barren and useless in itself, but a firm basis upon which to build the structure of practical experience. Book learning, abstract knowledge, is like fertilizer; it does not, of itself, produce anything, but it stimulates growth and advance when the live seed, practical experience, is instilled into the soil.

4. *Periodic Instruction Indispensable to Efficiency.*—

(a) The naval profession is the most varied in the world; leadership, material, skill, judgment, operations—all are needed. The term "officer" is synonymous with "leader," which establishes the primary reason for existence of officers. In the earlier years of an officer's career, he is concerned with the exercise of his profession in employments of limited scope. As he advances in rank and experience, the performance of details becomes less important. In the higher grades "operations" becomes of paramount importance, while material and its manipulation, though essential, are viewed as the means to the end, and not, as earlier, the end itself.

(b) The naval officer required a working knowledge of many branches of human endeavor. At present, he is "educated" only in preparation for the lowest commissioned grade. In order to be of most benefit to the service and the country, in these days, he must not only be expected to interest himself of his own volition in the progress of matters which have a bearing on naval warfare, but the time must be set aside and the opportunity must be made for him to acquire up-to-date knowledge along professional lines. It is also the case that the education preparatory to initial commission does not, nor can it be expected to, prepare the naval offi-

cer thoroughly for other than the duties he will be called upon to perform as a junior officer. It is an introduction to the profession but is not, and cannot be, complete in itself, even were still more time allotted to instruction at this initial stage.

(c) Not only does progress in knowledge and in other matters affecting the naval profession take place, but even in the extreme case in which these matters might conceivably be considered stationary, the Government should, at recurring periods in a career of forty years' commissioned service, provide the time and opportunity for officers to be instructed along the lines with which their increasing rank and consequent responsibility calls them to be thoroughly familiar. The extreme case appears to be: Instruction for four years at the Naval Academy and then none for forty years of commissioned service. The Board considers recurring instruction periods (later defined and specified) as indispensable to efficiency.

(d) Successive periods of instruction and training occurring at intervals between periods of practical experience is the best means to develop judgment, which, in positions of great responsibility, is an attribute which is hardly of inferior importance to the ability to reason to a logical conclusion.

5. *General Outline of an Officer's Commissioned Service.*—

(a) The general progress of an officer's career is clearly indicated in nine stages which are represented by the several grades in the naval service: ensign, lieutenant (junior grade), lieutenant, lieutenant commander, commander, captain, rear admiral, vice admiral, admiral. These grades or their equivalents exist not only in every military and naval service in the world, but also in all so-called "civil" establishments whether government or private; the grades or stages are therefore generally representative of advance in experience and ability and in consequent responsibility and authority.

(b) In armies, the nine grades are considered to be comprised of three distinct phases, each consisting of three grades, or stages:

First three—company officers—officers of small units.

Middle three—field officers—command of larger units of one kind.

Last three—general officers—command of mixed units.

(c) The analogous case exists in the navy, but not quite in the same form, because of the necessities of the case in respect to the upkeep, operation and interior economy of ships, an element which has no counterpart in an army; there are, however, distinct phases which appear to be four in number:

I.	Ensign Lieutenant (j. g.) Lieutenant	Inferior subordinates; *e. g.*, division officers.
II.	Lieutenant Lieut. commander Commander	Superior subordinates; *e. g.*, heads of ship departments.
III.	Lieut. commander Commander Captain	Commanders of ships.
IV.	Rear admiral Vice admiral Admiral	Commanders of small and large groups of ships.

6. Accepting the principles expressed in the above paragraph, four periods of instruction (training) are found necessary, to be so distributed through the naval officer's career as to make it the general rule that an instruction period precedes the employment in an advanced phase of usefulness (as indicated in paragraph 4 above). The four instruction periods are:

I. The Naval Academy.

II. The general line course.

III. The junior War College course.

IV. The senior War College course.

So that as

(a) The Naval Academy (initial instruction period) prepares for the earliest and lowest grade—inferior subordinate—so will

(b) The general line course (second instruction period) prepare for the second phase—superior subordinate—and

(c) The junior War College course (third instruction period prepare for the third phase—commanding officer—and

(d) The senior War College course (fourth instruction period) prepare for the fourth and highest phase—flag officer.

7. The length of time and the point in the service at which the instruction periods should take place are found to be:

(a) Naval Academy—four years—preliminary and preparatory to commission, in readiness for first phase of usefulness, *i. e.*—inferior subordinate.

(b) General line course—one year—between five and ten years after commissioning (preferably after five years' general service), in readiness for second phase of usefulness, *i. e.*—superior subordinate.

(c) Junior War College course—one year—between tenth and twentieth years of commissioned service (preferably while in the grade of lieutenant commander), in readiness for third phase of usefulness, *i. e.*, commanding officer.

(d) Senior War College course—one year—after twentieth year of commissioned service (preferably while in the grade of captain), in readiness for final phase of career, *i. e.*, flag officer.

8. *The First Period—Naval Academy.*—The primary objects of the instruction and training of midshipmen at the Naval Academy are considered to be:

(a) To develop the mental capacity; principally the ability to reason to a logical conclusion.

(b) To develop military character, including discipline, the attributes of leadership, and the basic virtues.

(c) To supply knowledge of the technical groundwork of the profession.

The Board has no comment to make in regard to (c) above, but suggests that special attention be given to the development of the reasoning powers by direct means as well as by the indirect methods now in use; and also that steps be taken to improve the development of those aspects of military character relating to leadership. Emphasis is placed upon these two matters because the quality of leadership and the power of reasoning are indispensable attributes of an officer, regardless of rank or employment.

9. *The Second Period—General Line Course.*—The function of the general line course is the unification and confirmation of initial instruction and experience of officers, and their progressive and advanced instruction in preparation for duties of the next higher

order. The general line course effects the following purposes (letter consecutively with paragraph 8 above):

(d) To continue the development of the powers of analysis and reasoning.

(e) To confirm and to bring up-to-date the professional instruction of the Naval Academy from the view-point of at least five years' sea experience.

(f) To unify, and, as far as possible, to equalize the information acquired while performing assigned duties at sea.

(g) To introduce officers to some of the more advanced elements of their profession.

(h) To acquaint officers with the fundamental considerations which control economic, political and social relations.

The arrangements for this purpose proposed in Reference (b) are considered well adapted to the initiation of this essential part of the education of a naval officer. The general line course is recommended to be put into effect at the earliest practicable moment with as many officers in attendance as can be spared; and regardless of whether all eligible officers can, in the beginning, be detailed for this course or not.

10. *Instruction for the Duties of Command.*—

(a) The aim of the training system in higher command should be to meet service requirements not alone in commanders of fleets, squadrons, capital ships, and in departmental planning and administration, which need the present War College will ultimately meet fairly well; but also the need for commanders of smaller vessels, upon whose decisions the results of many important phases of tactics and strategy during war will depend, and the need for members of flag officers' staffs competent to do strategic planning, formulate doctrine, etc.

(b) When the present class at the War College graduates next June, 28 per cent of all admirals and 24 per cent of all captains on the navy list will hold War College diplomas; while only 5 per cent of all commanders and ½ per cent of all lieutenant commanders will hold them.

(c) Present policy with respect to rank of students will increase the percentage considerably in the higher grades—which appears essential—without materially affecting the percentage in the lower

grades—which appears unwise, considering the important duties which commanders and lieutenant commanders will be called upon to perform in war, as second in command of capital ships and as commanding officers of other important, even though small, fleet units.

(d) Our fleets cannot have sufficient cohesion in war operations unless the body of commanding officers as a whole has a common conception of war and is uniformly indoctrinated. These are difficult conditions to fulfil, unless the body of officers in the third and fourth phases as a whole receive adequate education and training in the higher branches of war.

(e) To meet the above need it is essential to establish a course of instruction for officers of the rank of lieutenant commanders (and perhaps junior commanders) who are approaching the third phase of their careers.

11. *The Third Period—Junior War College Course.*—This course fills the need for a periodic unification and confirmation of instruction and experience after about fifteen years' commissioned service, and provides for a continuation of instruction along advanced professional lines in preparation for prospective employment as commanding officer. Its functions (lettered consecutively with paragraphs 8 and 9 above) are considered to be:

(i) To continue the development of the powers of analysis and reasoning, particularly as to applications which arise in naval operations and warfare.

(j) To unify, confirm, and equalize service instruction and experience in technical matters.

(k) To confirm and continue instruction in the advanced elements of the profession, including training in the application of the doctrine and principles of naval warfare.

(l) To confirm and increase knowledge of economic, political and social sciences in theory and practice.

12. *The Fourth Period—Senior War College Course.*—This final phase in the scheme of training line officers is intended to provide a confirmation, summary and adequate familiarity with the higher advanced elements of the profession, chiefly those principles which govern in the administration, operation, and functions of forces and fleets, in readiness for prospective employment as

flag officers. Its principal parts (lettered consecutively with paragraphs 8, 9 and 10 above) are considered to be included in:

(m) To insure thorough understanding and facility in application of the principles and considerations which control the organization, administration, operations and functions of fleets and of fleet units.

(n) To insure comprehensive appreciation of the functions of the several offices and bureaus of the Navy Department and of bases and other shore establishments.

(o) Confirmation and continuation of instruction and training in the advanced parts of the profession, to insure thorough familiarity with the governing principles of international relations, strategy, tactics, logistics, etc.

13. The highest interests of the Government require that not only shall time and opportunity be provided for the above recommended instruction and training, but it should, for the purpose of maximum efficiency, be made obligatory, in order that the greatest possible benefit may be gained by the service as well as the individual. The necessary arrangements include the addition of a percentage to the personnel estimates, in order that while the necessary numbers required by other employments are not diminished, the numbers undergoing instruction for the necessary periods may be kept at full strength. It appears that the percentage in question is approximately nine per cent of commissioned line officers for all purposes, *i. e.*, 4 per cent taking general line course, 3 per cent the junior War College course, and 2 per cent in the senior War College course.

PART II. SPECIALIZATION

14. The necessity for instruction and training gains greater emphasis when endeavor is made to group the numerous and varied requirements of the naval profession into suitable and convenient "specialties," or lines of endeavor. The requirements of the naval profession are found to be such that provision must not only be made (a) for the progressive instruction of officers at recurring periods as recommended above, but also (b) for the specialization of all officers in at least one branch of the profession, in order to insure that full knowledge and use may be made of the

constant progress in all of the arts, industries, and sciences, which can in any way contribute to the advancement of efficiency of naval warfare in any of its manifold aspects and requirements. In some cases these requirements may be met by attendance at special schools, and in others by assignments to duty.

15. It is apparent that no officer can be really expert in all branches of the naval profession. It is, therefore, necessary that each officer specialize in at least one specific branch of the profession, in order that he may make a profitable exchange by giving his special knowledge and experience in return for that of others. While each officer gives the knowledge of one man, and that without taking away from himself, he receives in turn the ideas and information of many. The business principle, "that exchange is best which gives both parties the largest possible profit," has been found as successful in the exchange of knowledge as of commodities.

16. All naval officers should be experts in certain fundamental branches of the profession. Each officer should be a specialist in at least one specific branch of the profession.

Specialists should be of five general classes:

(a) Those officers of the line who specialize in a technical material branch with a view to supervising the design and production of material.

(b) Those officers of the line who specialize in a technical material branch with a view to becoming expert in the manipulation of the material of such branch.

(c) Those specialists who remain in the line of the navy but are limited to the performance of duty of a particular type.

(d) Those officers of the line who specialize in branches of the profession other than the technical material branches.

(e) The staff corps and the Marine Corps.

17. *Specialists in Design and Production.*—

(a) To a large degree, the navy designs and supervises the design and production of its material equipment. Each officer cannot specialize in each branch of the profession sufficiently to prepare him for this important duty. It is, therefore, necessary to train a certain number of officers as specialists in design and production. Some of these officers will later be assigned to special

duty only, but most of them will continue in the regular line duties, their abilities as specialists being employed only on short duty and in connection with manipulation of the material of their specialty at sea.

(b) No specialization of this nature should be permitted until after the completion of five years' sea duty and a satisfactory completion of the general line course. (See paragraph 22 following.)

(c) No officer should be permitted to specialize in any branch unless by his work in the general line course he has demonstrated that he is especially well qualified for such duty. In many cases the decision as to which branch an officer should be assigned for specialization should be determined by the staff of the General Line School. (See paragraph 22 following.)

(d) The general line course is a necessary preparatory step to specialization of any nature within the line of the navy. Specialists in design and production should, if practicable, take up the study of their specialty immediately succeeding their completion of the general line course. (See paragraph 22 following.) This special course should be as at present:

One year—post graduate "groundwork" school; then
One year—civil college or university.

18. *Specialists in Manipulation of Material.*—

(a) The manipulation of the mechanism of modern ships is so complicated that it should be supervised by officers who have had special instruction and training in its manipulation. This necessity introduces into the service specialists in the supervision over the manipulation of certain mechanical technical departments on board ship.

(b) These specialists, however, remain in the line of the navy and after performing the work connected with their specialty follow the route of the line officer unrestricted as to the type of duty to be performed.

(c) In view of the knowledge and experience gained by five years' service, and the review of technical subjects received in the general line course, it is considered that a six months' to one year's course should be adequate for qualifications as an expert in supervision of manipulation.

19. *Specialists for Special Duty Only.*—Specialists of this class should not be selected until they have demonstrated their proficiency in the elementary stages of specialization and in the performance of duty in the specialty. The existing law permits this selection only after reaching the grade of lieutenant commander, which arrangement is considered satisfactory.

20. *Other Specialties Pertaining to Line Requirements.*—

(a) It is believed that each officer should be a specialist in some branch of the naval profession. The study of leadership, management of personnel, the conduct of naval operations, organization and administration and of the purely seafaring knowledge such as seamanship and navigation, furnish ample ground for many specialists. The specialization in these branches is not inconsistent with the performance of normal duties.

(b) Specialists of this class are required, primarily, to study and investigate the ground covered by their specialties, in order to furnish to all officers in the service the most advanced views on these important subjects. Every element of the naval profession must be studied and the knowledge obtained by individual officers classified, collated and disseminated throughout the service for the benefit of the whole body of naval officers.

21. *The Staff Corps (and Marine Corps).*—

(a) The Staff Corps are divided into two classes:

Combatant: naval constructors, supply officers, civil engineers;

Non-combatant: Medical and dental officers, and chaplains.

(b) The instruction of officers of the staff corps is herein touched on only insofar as the proper performance of their duties requires training similar to that of the officer of the line.

(c) So far as practicable, all officers of the combatant staff corps should be graduates of the Naval Academy. The basic instruction of all combatant naval officers should be identical. The spirit of unity which should pervade all branches of the profession will be materially increased by this common education and the friendship and ties formed at the Naval Academy will materially increase the co-ordination of the branches within the service.

(d) The medical officers, dental officers and chaplains cannot be trained at the Naval Academy, but the Medical School in Wash-

ington should include in its curriculum the study of leadership, military character, etc. A short course should be arranged for dental surgeons and chaplains entering the service in order that they may have a broader conception of their duties on board ship and their relation to the personnel and the service.

(e) Officers who are to be naval constructors and civil engineers should serve at least two years at sea and should preferably (see paragraph 22 following) complete the general line course before commencing the study of their specialties. This course is essential in order that such officers shall realize that the various branches of the navy must work in harmony and that these officers may bring up to date their general knowledge of the profession before they specialize in any one branch.

(f) Graduates of the Naval Academy (or appointees from civil life) selected for the Marine Corps and Supply Corps should be immediately assigned to schools for instruction in their particular specialties, upon completion of which they should be ordered to the regular duty of the branch.

(g) The training of these officers should be provided for as follows:

Marine Corps: Marine Officers' School.

School of the Line (Marine). (All marine officers.)

School of the Line (Army). (Specially selected officers.)

Junior War College (Navy). (Specially selected officers.)

Staff School (Army). (Specially selected officers.)

Senior War College (Navy). (Specially selected officers.)

Staff College (Army). (Specially selected officers.)

Supply Corps: supply officer school (pay corps). (All supply officers.)

Junior War College (Navy). (Specially selected officers.)

Senior War College (Navy). (Specially selected officers.)

22. *Temporary Exceptions from General Line Course.*—

(a) It is deemed desirable, and even necessary, that *all line officers* shall take and satisfactorily complete the general line course before taking up their several specialties, for the reasons, given in the several paragraphs preceding. This view is also held in regard to naval constructors and civil engineers.

(b) However, since there is a shortage of officers which is expected to continue for some years, and as the post-graduate technical education which certain selected officers receive is useful in giving perspective and breadth of view, it is considered that the general line course requirement need not be made obligatory until the shortage of officers is materially reduced.

PART III. PRACTICAL CONSIDERATIONS

23. *Initiation of Recommendations.*—It is realized that the recommendations made above cannot well be initiated in their entirety at once, due to shortage of officers, the requirements of the service and for other similar reasons. The Board would strongly press, however, the necessity for the adoption of a well-considered plan such as this report is believed to contain in order that affairs may be regulated and arrangements made for eventually bringing the definite plan into full force and effect. The Board has indicated (in paragraph 22 above) where certain temporary modifications can be made but would urge, as indispensable to the efficiency of the service, that beginnings be made in all the several lines of instruction and specialization. The recommended training provisions can be got underway at once by utilizing the arrangements proposed for the general line course in Reference (b) and the facilities at the War College for the separation of the present War College course into the recommended junior and senior War College courses. Specialization of the kinds classified in paragraphs 18 and 20 above can be largely effected in the beginning by suitable details to duty afloat and ashore.

24. *General Graph of Employment—Ensign to Commander.*—

(a) An endeavor has been made to indicate, by means of the graph, which appears herewith as Enclosure "A", the progress of a line officer through his naval career from the date of his entrance to the Naval Academy until the completion of his junior War College course, assuming that the plan of instruction recommended by this Board is in effect.

(b) All line officers should be graduates of the Naval Academy or should have had extensive practical experience in the enlisted and warrant classes and training in a school of application.

(c) Upon the completion of the Naval Academy (or School of Application course) each officer should be ordered to a ship of the first rate for a period of from about two years. This period should be two years for those officers who desire to enter the Construction Corps or Civil Engineer Corps.

(d) From ships of the first rate officers are transferred to one of the following duties or types of ships:

(1) Aviation duty.

(2) Submarine duty.

(3) Destroyers.

(4) Light cruisers.

(5) Mine force vessels.

(6) Cruisers or gunboats.

(7) Auxiliaries.

(8) The nature of the duty to which officers are to be ordered should be dependent upon several factors:

I. Their desire for certain duty.

II. The recommendation of their commanding officer.

III. The available billets in the type desired.

IV. Their reports of fitness.

(e) Officers should, so far as practicable, remain in the type of ship (as listed in subparagraph (d) above), to which they are ordered until their first period of sea service (five years after graduation) has been completed.

(f) All officers of the same class or date of commission finishing their sea service together would be ordered to take the general line course.

(g) The curriculum of the general line course should be such as bring their knowledge of all technical branches of the profession up to date and to advance them in their knowledge of the profession, especially the elementary subjects of the operation branch.

(h) During the general line course student officers will be carefully watched by their instructors to determine in what branch of the profession (as indicated in paragraph (j) below), each officer should specialize.

(i) There should be no requirement to continue a previous duty in aviation or submarines unless the officer so desires and is recommended therefor.

(j) Upon completion of the general line course, officers will take up one of the following specialties:

(1) Operations specialties.
(2) Manipulation specialties.
(3) Design and production specialties.

(k) This specialization is made effective by:

(1) Schools.
(2) Duties assigned.

(l) The following schools should be provided for:

(1) Operations school (2) Communications school (3) Ship control school (4) Aviation schools (5) Submarine schools (6) Engineering school (7) Gunnery school (8) Electrical school (9) Torpedo school	Course six months to one year.

(m) These schools need not each be independent. It is possible and preferable that, so far as practicable, these should be extension branches of the general line course and should be located in the same place though not necessarily in the same building.

(n) In addition to these schools there should be a post-graduate "groundwork" school for those officers who are to specialize in design and production. These officers upon completion of this post-graduate "groundwork" school course (one year) are ordered to civilian colleges for one year and then to sea duty.

(o) Officers assigned to any of the schools mentioned in paragraph (1) above complete the course and are then ordered to shore duty consistent with their specialty for the remainder of their time ashore.

(p) In view of the shortage of officers in the navy it will be impracticable to give all officers post-graduate work as described in paragraphs (m) and (n). Such officers should be assigned to definite specialties and ordered to shore duty where their duty and

training will assist them in their specialty. The diagram indicates duties of this nature to which officers may be assigned.

(q) Upon completion of this shore duty officers are ordered to sea duty in accordance with their specialties so far as practicable and the same considerations govern the succeeding shore and sea duty.

(r) By this time full use has been made of the specialization of these officers and they must be brought more closely together in preparation for command duty.

(s) This preparation is the function of the junior War College course. Upon completion of this course officers of the line who desire to specialize to the exclusion of command duty should be selected, as mentioned in paragraph 19 above.

25. (a) The scope of the Board's considerations has been such as to involve what may be called the framing of the "general specifications" of, first, the arrangements for the periodic and unified instruction and training of all line officers and, second, the provisions for the universal specialization necessary to the maximum development of the efficiency of officers and of the service. The Board has had at hand data which enables it to indicate the specific measures necessary to put into effect the training requirements for all line officers but is unable to go into the details of the provisions for specialization.

(b) General supervision of the training system should be provided in order to ensure due co-ordination among the several schools; otherwise there may be duplication of instruction, omission of some subjects essential to the harmony of a broad educational scheme, and a conflict of doctrines.

(c) Such supervision appears best obtainable by a permanent board on the training of officers, including among its membership the head of each school, representatives both of the Chief of Naval Operations and of the Bureau of Navigation, and such additional civilian or other members as may be determined upon. The secretariat of this board should be provided for and maintained by the Office of Operations.

UNITED STATES NAVAL ACADEMY

Post Graduate Department
Annapolis, Md.

Aug. 27, 1919.

To: Secretary of the Navy (Bureau of Navigation)
Subject: Proposed General Line Course, Post Graduate School.
References: (a) C. in C. letter file 1036 of 20 February, 1919.
(b) Operations 1st end. No date.
(c) Bunav. 2d end. N. 31 ATB-VAW of 18 April, 1919.
(d) Post Graduate Department letter 324 of 30 June, 1919.
(e) Bunav. letter No. 8039-198 of 31 July, 1919.

1. In reference (a), a recommendation to establish a course for education and training of officers for staff duty was submitted. References (b) and (c) approved the recommendations of reference (a) with a view of establishing the course at the Post Graduate School.

2. In reference (d) it was proposed, in lieu of the staff course, to establish at the Post Graduate School a "general line course" for the advanced instruction of commissioned line officers in professional and allied subjects, in order that the education of naval officers in general may be rounded out in more complete preparation for the many varied duties to which they may be assigned. The necessity of such procedure is supported by systems of post-graduate work employed by other nations, and by our army in its systems of schools for progressive advanced education of officers.

3. The general line course is designed to augment the elementary theoretical education received at the Naval Academy in the light of the practical experience at sea, with the object of broadening the officer's viewpoint and perspective beyond the limit of matters relating to interior organization and administration of the individual ships in which he has generally been engaged, in order that the efficiency of both the individual and the service at large may be increased. It will also serve advantageously to augment the Naval Academy course of those members of classes which were graduated, during the war, in three years.

4. The general line course will consist of pertinent review and instruction along the following principal lines:

(a) Up-to-date instruction in professional subjects; navigation; seamanship; ordnance and gunnery; electrical engineering; marine engineering; naval construction; etc.

(b) Advanced instruction in the principles of command, including organization, administration and maintenance, operations, including logistics and communications; international relations and intelligence; personnel matters, including military law and discipline; the planning, analysis and summarization of gunnery, engineering, and other exercises, etc.

(c) Lectures and instruction in general science and in the elements of logic, political economy, modern history, exposition, etc.

5. The following outline of the proposed course is submitted in accordance with paragraph 2 of reference (e). The course is outlined to cover

a period of one year divided into three terms with time employed as indicated in the following table (*Note:* subject to change as conditions and necessity warrant):

Subject	I term No. of hours		II term No. of hours		III term No. of hours	
	Class	P. W.	Class	P. W.	Class	P. W
How to study	12	..	..	..	..	..
English exposition	16	..	..	..	..	..
Seamanship	12	15	6	..	..	..
Navigation	16	20	8	..	..	..
Ordnance	14	15	6	..	..	..
Gunnery	14	20	8	..	..	..
Marine engineering	20	35	10	35	..	..
Naval construction	8		4			
Electrical engineering	20	35	10	35	..	..
Radio	8		4			
Precision of measurements	12	35	..	..	..	..
Graphs	16					
Organization	..	..	9	..	..	..
Command	..	..	10	..	..	..
Administration	..	..	9	..	..	..
Scientific methods	..	..	..	..	14	..
Scientific land marks	..	..	..	..	14	..
Operations	..	..	28	35	42	105
Communications	..	..	..	..	42	70
Maintenance	..	..	16	35	..	..
Logistics	..	..	12			
Political economy	..	..	..	..	14	..
Political science	..	..	..	..	14	..
Policy	..	..	..	..	14	..
International law	..	..	..	..	14	..
Planning	..	..	14	35	..	..
Analysis and summarization	..	..	14			
Totals	168	175	168	175	168	175

Grand total: 1029 hours.

NOTE:—1. One hour each day except Saturday will be employed in physical training and exercise.

2. Each day is divided into five periods, *i. e.*, two one-hour periods for recitation, one hour of preparation, one hour of athletics (Saturday lecture), two and one-half hours in afternoon for practical work and exercises.

3. Examination will be conducted at the end of each term.

6. In general terms, the detailed requirements in the various subjects are as follows:

(1) *Seamanship.*—General review of elements, principles and applications, including types of ships, fittings and mechanical appliances; piloting; tactical data and methods of determination; handling and

steering ships singly and in formation, surface and submerged; towing; sweeping; boating; otter gear; nets; buoys; ground tackle; cargo stowage and handling; salvage; diving; rules governing organization and operation of merchant vessels; rules of the road; weather and laws of storms; current articles on handling ships in heavy weather; shoring; watertight integrity; mooring board problems.

(2) *Navigation.*—Theory and practice, including the duties of the navigator; description; use, and adjustment of the various navigational instruments and machines applicable to surface, underwater and air craft; charts, method of construction, general use, corrections and stowage; publications such as "notice to mariners", light and buoy lists, sailing directions; conventional notations and signs on charts; piloting and various methods of locating a ship's position near land; danger angles and danger bearings, serial and submarine fog signals; sailings; descriptions, care, and use of chronometers; different kinds of time used in navigation, the relation of same, and the conversion of time; the relation of sidereal time, hour angle, and right ascension; general solution of astronomical triangle; effects of errors in data and a consideration of the best time to observe for latitude, time, and azimuth; chronometer errors and methods of determining; rating; various methods of finding latitude, longitude and lines of position; the day's work; tides, currents, times of high and low water; identification of heavenly bodies; use of tables; solution of practical problems; theory of the deviation of the compass, description, errors, compensation, correction, care of both magnetic and gyro compasses; practical problems of chart room work, laying down courses and distances; plotting position, lines of position, contour lines, danger bearings, etc., and application of general rules of pilotage; use of sounding data, radio and sound signals in foggy weather; aids to surface, aerial and submarine navigation; military geography; observations with sextant and artificial horizon for longitude chronometer correction, latitude and azimuth; practical works.

(3) *Marine Engineering.*—History and progress of marine engineering with particular emphasis on late developments; theory of steam, air, and internal combustion engines; care, operation and upkeep of power plants of the several classes; specifications; trials standardization of indicators, gauges, instruments; metals, alloys, processes; boilers, design; general description; nomenclature and comparison of the several types; care and management of boilers; developments in oil burning; reduction gear; turbines; materials, physical properties and tests; thermo-dynamic applications; evaporating plants; Department bulletins and pamphlets; practical works and exercises.

(4) *Naval Construction.*—Types of hull and fittings; compartmentage; draining; underwater protection; specifications and characteristics for various classes including controlling influences; stability; aircraft; care and preservation.

(5) *Electrical Engineering.*—Elementary physics, electro-statics; storage batteries; instruments; elements and applications of D. C. and

A. C.; electrical machinery including generators, motors, rheostats, resistances, controllers, circuit breakers, detectors, insulations, wiring and appliances, transformers, alternators; electrical communication; switchboards; distribution boards; windings; tests, measurements; installations; electrical propulsion installations, care and operation; principles and application of wireless telegraphy; and telephony; listening devices; aeronautic instruments; practical exercises and laboratory work.

(6) *Ordnance and Gunnery.*—Gunnery instructions; developments in guns and mounts; battle ranges as affecting caliber; ammunition hoists; shells; explosives; mines; depth charges; torpedoes; bombs; optics; turret design and machinery; fire control methods and installations; director systems; ballistics; elements of dispersion and steps to eliminate; practical work and exercises with models at hand; ordnance pamphlets and instructions; inspection, care, operation and preservation of ordnance material; lessons derived from experiences of the war.

(7) *English.*—How to study; exposition, including principles of whole composition, paragraphs, sentence and word; outline development; transition; coherence; unity; limitation of subject; convergence; conclusions; punctuation; structure; political economy; political science; modern history; logic.

(8) *Command, Organization and Administration.*—Principles and application in the service generally and in the fleet in particular; pertinent parts of Navy and Fleet Regulations and Instructions; special instructions; organization sheets; general orders; administrative outlines; diagramatic representations; fleet standing orders; fleet routine orders; general orders; finance; etc.

(9) *Operations.*—Units and fleets; exercises; campaigns; movements; schedules for exercises in strategy and tactics; estimate of situation; formulation of orders; scouting; service of information and security; training; elements of gunnery and engineering efficiency; intelligence; war plans; inspections; performances; employment; practical problems, etc.

(10) *Personnel Matters.*—Health; welfare; military character; recreation; complements; training and transfer; military law and discipline as given in naval courts and boards, Naval Digest, courtmartial orders and special instructions.

(11) *Communications.*—Preparation and handling of correspondence and despatches; signal books; codes and ciphers; regulations, both navy and communication; applications and methods.

(12) *Logistics.*—Movements, supply of funds, fuel, ammunition, stores, equipment, provisions, clothing, transportation; ships data: train; bases, fixed and advanced; repairs; alterations; overhaul schedules; facilities; routine reports; inspections; tests; experiments; availability; maintenance and instructions governing same.

(13) *International Relations.*—Rules governing maritime warfare, usage, customs, ceremonies, duties of Naval Attache.

(14) *Planning; Analysis* and *Summarization* of gunnery, engineering and other exercises; orders of execution; rules, reports.

(15) *Policy.*—Means and methods of preparation for war, strength and character of types in ships, personnel, bases, fortifications; influence of geographical location; political relations with probability of war with other powers, and influence of alliances and coalitions; statistics on navies of other powers, both personnel and material; doctrine.

(16) *Precision of Measurements and Graphs.*—Theory of probability; determination of precision of observation by consideration of average deviation from the mean; relation between precision and the number of significant figures retained in computation; treatment of direct and indirect measurements; criteria for rejection of observations; propagation of error; discussion of relation between variables indicated by experimental data; discussion of types of equations with reference to suitability to represent by graphs; empirical data; empirical equations.

7. It is considered desirable that the first term in this course begin about 1 October, 1919, and that about 20 officers of the Naval Academy, classes of 1912, 1913 and 1914, be assigned. The number of students should increase rapidly from year to year until conditions and facilities are such that a whole Naval Academy class may return for the course.

8. It is planned, for the present, to carry on the instruction in the above-outlined course with the present Post Graduate Department faculty and facilities of the Naval Academy, thus involving no additional expense.

U. S. NAVAL INSTITUTE

SECRETARY'S NOTES

Membership

Life, regular and associate membership, 5460. New Members: 8. Resignations: 25. Deaths (7).

Lieut. Commander B. M. Snyder, U. S. Navy.
Captain O. E. O'Neill, U. S. M. C.
Lieut. R. L. Vaughan, U. S. Navy.
Lieut. F. W. Lively, U. S. Navy.
Ensign C. A. Wildman, U. S. Navy.
Rear Admiral O. W. Farenholt, U. S. Navy.
Captain G. R. Venable, U. S. Navy.

Dues

The annual dues ($3.00) for the year 1920 are now payable.

Regular and associate members of the U. S. Naval Institute are subject to the payment of the annual dues until the date of the receipt of their resignation.

Address of Members

All members are urged to keep the Secretary and Treasurer informed of the address to which PROCEEDINGS *are to be sent, and thus insure their receipt.*

Members and subscribers are urged to notify the Secretary and Treasurer promptly of the non-receipt of PROCEEDINGS, in order that tracers may be started. The issue is completed by the 15th of each month.

Book Department

The Institute Book Department will supply any obtainable book, of any kind, at retail price, postage prepaid. The trouble saved the purchaser through having one source of supply for all books, should be considered. The cost will not be greater and sometimes less than when obtained from dealers.

Reprints of Articles

The attention of authors of articles is called to the fact that the cost to them of reprints other than the usual number furnished, can be greatly reduced if the reprints are struck off while the article is in press. They are requested to notify the Secretary and Treasurer of the number of reprints desired when the article is submitted. Twenty copies of reprints are furnished authors free of charge.

Illustrations

Authors of articles submitted are urged to furnish with their manuscript any illustrations they may have in their possession for such articles. The Institute will gladly co-operate in obtaining such illustrations as may be suggested by authors.

Original photographs of objects and events which may be of interest to our readers are also desired, and members who have opportunities to obtain such photographs are requested to secure them for the Institute.

Annual Election

Proxies for the annual election have recently been mailed to the membership. It is requested that all members fill these out and return to the Institute as soon as possible.

Notice

Whole Nos. 6, 7, 10, 13, 14, 15, 17, 144, 145, 146, 147, 149, 155, 167 and 179 of the PROCEEDINGS are exhausted; there are so many calls for single copies of these numbers that the Institute offers to pay for copies thereof returned in good condition at the rate of 75 cents per copy.

ANNAPOLIS, MD., July 15, 1920.

INFORMATION INDEX

PROFESSIONAL NOTES

PREPARED BY

LIEUT. COMMANDER H. W. UNDERWOOD, U. S. Navy

GENERAL ARRANGEMENT

FRANCE

FRENCH NAVY NOTES.—Since maritime expansion is par excellence the outward expression of the political and economic vitality of nations, naval interest attaches to the rapidity with which France is recuperating from the devastation and ruin inflicted without raison militaire by the hand of the infamous Hun. Practically the whole devastated area (3,200,000 hectares) has been cleared of projectiles, and half of it has already been tilled. Of the 5000 kilomêtres of railroads that had been destroyed, 4000 have been reconstructed, as well as 3500 tunnels and bridges, whilst out of the 11,500 factories and mills that have been systematically destroyed or plundered, nearly 7000 have been reconstructed or placed anew in working order, which means a gigantic task that it will, of course, take years to fully complete, as all combatants know, though the Boche has failed in his object to permanently cripple that land of miracles Old Gaul.

The sporting fever has taken hold of the Navy which, as decided by the progressive Minister of Marines, is to take a prominent part in the London and Antwerp athletic competitions and to welcome any challenge from our British friends on the sporting field, for which preparations are being made at Cherbourg and Toulon. Mathurin is shortly to show what he can do in the Paris Regatta. Thus a promising new era is opening for French crews that can but improve in all-round quality.

A noteworthy feature of the protracted and eventful world-conflict was the long series of changes that took place in the command of the belligerent armies and fleets. Both the British Army and Fleet changed their heads twice, whereas three successive commanders have been in charge of both the French Army and Navy, Lapeyrère, Dufournet, and Gauchet in turn acting as Admiralissimos. As in the case of Marshal Joffre and of Gen. Nivelle, political intrigue rather than actual failure in their command caused the removal from active duties of the French naval chiefs.

The case of Adml. Dartige du Fournet is the most amazing, and, courts-martial being now very fashionable, it may become shortly the object of a Conseil de Guerre. This distinguished flag officer was, it will be remembered, in charge of the French battle fleet at Athens in December, 1916, when a party of French officers and sailors were treacherously attacked and murdered by orders of ex-King Constantino. He was relieved of his command by Minister Lacaze "for not having upheld with sufficient vigor the prestige of the Tricolor and avenged the foul murder of his seamen." The battleship *Mirabeau* had then fired a few well-aimed 12- and 9.4-inch shells on the Royal Palace, just the number sufficient to bring the traitorous Tino to his senses and to obtain the surrender of Greek artillery. The French Commander-in-Chief had the means of reducing Athens to ashes. Under similar circumstances a Boche admiral would not have hesitated a minute. But the chivalrous admiral, who had previously shown his decision in several instances and notably as second of Capt. Bory at the attack of Bangcock (1893), has nothing Boche in him, and for the sake of Old Greece and of civilization he refrained from bombarding and destroying wholesale some of the finest art treasures of antiquity, not wanting besides to visit on many thousand innocent people the crime of a few rascals. It is certain that France's position in the Levant is all the better to-day for the generous course adopted by Mons. Dartige du Fournet. Baby-killing, moreover, is not in the French line. Still, since the scandalous impunity enjoyed by Boche war criminals, there are not a few military and naval experts on this side who think that "next time" it would be an absurdity and weakness for France to try and "humanize war" and to refrain from "hitting first, hard and long" on these magnificent targets which large Boche cities and industrial centers offer to aerial bombardiers and to super-cannon. Safety lies along that course.

There have been of late a large increase in the number of 700-850-ton avisos, commissioned for auxiliary duties with the fleet and on colonial stations, where these gunboats form the French counterpart to the fine ultra-rapid British cruisers of the "C" and "D" classes, and there is less and less tendency on the part of our naval men to boast of these war acquisitions, that are both in their hulls and motors patched up, badly-designed affairs, little more than make-believe from a military standpoint and laughed at by every experienced constructor. The lines are faulty, the nautical qualities deficient, and the silhouette ridiculous, resembling neither a bonâ-fide cargo boat nor a warship. "C'est l'œuvre d'apprentis-ingénieurs," declared an old naval man, and a similar observation is being freely applied to the 1400-ton cargo boats of the *Verrier* type, also designed by good-intentioned gentlemen of La Section Technique, and which, despite satisfactory paper qualities, have turned out to be somewhat lacking in structural robustness and nautical qualities, so much so that there is no undue haste to sail in them. This shows that personal acquaintance with sea conditions is no less necessary than scientific attainments for the efficient designing of sea craft. The truth is that our "ingénieurs du Génie Maritime," who are over 150 in number, possess superior capabilities so far as theoretical paper work is concerned, their mathematical training absorbing much more time and attention than is the case in any other navy, but, on the other hand, their practical and business training leaves much to be desired, and it has long been felt that the whole branch is in need of a thorough reorganization on new lines. There is something to be learnt in this respect from the British and American navies. Already a "mission" of ingénieurs d'artillerie navale" under General Charbonnier has been sent to visit American gun factories, and it is probable that Paris constructors, who have given up warship designing for the last five years, will likewise seek information in those Allied yards reputed to lead in the matter of rapid and up-to-date construction.

The examination of recuperated Boche and Austrian scouts, though it has been no revelation to Paris experts, had led to minor changes in the projected éclaireurs, but the opinion is gaining ground that the whole cruiser program falls short of France's requirements, and no wonder. England and America can afford to excel both in the matter of number and quality, whereas our Republic, financially unable to compete with her great allies, has to be satisfied with superior quality, this being a sine-quà-non condition of the efficient peace rôle and war utilization of warships. Now, superiority means a two-fold advance over all contemporary designs for both speed and calibre, and notably the faculty of escaping from the deadly reach of all rivals with heavier armament. It is because it did not meet those requirements that the fine German cruiser force, that would have done wonders against France, proved of so little avail against the superiorly designed British ocean greyhounds. This means that the 5.5-inch calibre, however improved, is no longer adequate, the latest American and English light cruisers mounting 7.5- and 8-inch weapons; and as to the speed of 30 knots, it is ridiculously out of date in these times of 33- and 35-knot battle-cruisers and scouts. Such are the facts. Sea power is getting more and more expensive, and the longer the delay the heavier the outlay will become. Eloquence and literature are no remedy, unfortunately, for our peaceful Republic resembles in one respect the Seigneur Harpagon, the hero of Molière who wanted "beaucoup de bonne cuisine avec peu d'argent." Over 500,000,000 francs will be squandered this year in the upkeep of a huge army of useless parasites and anarchistic prolétaires des arsenaux, whilst the utmost parsimony presides over the measuring of the credits devoted to the forging of the weapons of the national defence. Still, it is felt action will have to be resorted to, and the curtailing of useless expenditure, that is proceeding steadily, will in a few months hence permit an effort to be made with a view to retrieving the situation in the Mediterranean, where our Italian friends are claiming supremacy. The super-Dreadnought *Caracciolo*, which was launched last month, is not likely to be completed without France adopting a similar step concerning the *Flandre, Gascogne,* and *Normandie*, that have not been officially discarded and could be ready, with minor ameliorations in their design, by the end of next year. The bulk of naval opinion is now in favor of the completion of these powerful super-dreadnoughts, that would procure France security and prestige in the Middle Sea. There are signs of a reaction in favor of the much-abused mastodon. Superior power is not attainable without superior size. In the present state of the naval science, and since the submarine and aerial menaces have been squarely faced and guarded against, David cannot be said to stand much chance against Goliath.—*The Naval and Military Record,* June 9, 1920.

FUTURE OF NAVAL AVIATION.—Should Minister Landry succeed in discarding the battleship programme and in doing away for a time with the mastodons "qui n'ont rien fait pendant la guerre," he will go counter to the desire of the bulk of naval men and deal a damaging blow to the naval prestige of the Republic, since there is no questioning the capital value of the mastodon to show the flag in peace time and to assert the command of the high sea. On the other hand, nobody can deny his work-power and his patriotic intentions to make up for the temporary weakening of the armored squadrons by an energetic expansion of the fleet along the lines of la jeune école. Even if financial considerations and his limited tenure of office should combine to prevent his securing for France that speed supremacy which Admiral Aube's powerful imagination pictured as the primary factor of success on the water and as the most vital asset for Powers financially and numerically outmatched (a somewhat contradictory ensemble of requirements), the capital service he will have rendered to naval aviation will ever be a feather in his cap and cause his Ministry to

be favorably remembered. For he is the first Minister of Marine to have entered Rue Royale with the set determination of making the Gallic Navy supreme in the aerial branch, and with the clear knowledge that an ambitious programme of that sort demands to be realized something more than that unexcelled verbal activity which is the glory of our Republic, viz., persevering will and a firm hand that will brush aside mercilessly those good-intentioned, but obsolete, officials whose narrow minds, cramped up with the beliefs of the dead past and with conventional doctrines, leave no room for new ideas and for the study of the rapidly-changing aspects of the war game, who too long have found delight in thwarting the efforts of the far-seeing pioneers of naval aviation and in sacrificing the interests of their country to their senile prejudice.

The official contention is that aviation is the line of naval activity in which the greatest results can be obtained in the shortest time with the least expenditure, although the creation of a really efficient aerial wing is not so easy a job as might appear at first sight to judge from the fact that "l'aviation navale Française," that was the first in the field, is yet in its infancy so far as the matériel is concerned and is under the obligation of defending its precarious existence against the ill-will and jealousy of the older branches of the services. Moreover, naval aviation is expected, with time, to command effectively narrow passages and those inland seas, such as the Mediterranean, which are studded with islands strategically suited for the rôle of offensive aerial bases. Secondly, France is deemed to be in a privileged geographical situation so far as the effective utilization of maritime aviation is concerned, only being excelled by Great Britain in that respect.

At the same time, it is clearly seen, on the morrow of the fiasco of the cross-Mediterranean flight, that a methodical and persevering effort has to be made before aviation can be considered as a thoroughly seaworthy weapon to be relied upon in all weathers. And the first condition necessary to success in this direction is to ascertain the causes of past failure and speedily remove them. If financial and industrial means of action, together with inventive genius and genuine enthusiasm on the part of young officers, had been the only things that were needed to create a powerful air wing, the 1911 Daveluy aerial programme, comprising scouts as well as fire control and bombardment hydravions, would have been ready at the time of the Boche aggression, and the whole course of hostilities might have been changed; the Goeben would not have bombarded French ports with impunity, Cattaro and Pola would have been promptly made untenable to the Austrian Fleet, and the underwater mosquito would have lost much of its sting. Unfortunately, as noted by Adml. Daveluy, "vouloir" was sadly wanting; that is, a well-defined and stable policy and unflinching will in the realization of the same, desiderata hardly compatible with the continual change of improvised Ministers (seven since 1914) and the consequent rise to the top of the naval hierarchy of gentlemen generally more eminent by their talent for intrigue and verbal attainments than by their solid practical qualities. A comparison between the parallel developments of French and English aviation speaks for itself. So far back as 1910 Admiral de Lapeyrére publicly confessed his enthusiastic belief in the naval possibilities of aviation, and the best brains of the service then tackled in earnest the study of the new problems, only to find out their powerlessness to achieve anything against the systematic inertia of the Admiralty bureau intent on demonstrating that seaplanes were "de fragiles jouets," and aviators mere lunatics, and delighted at the opportunity the outbreak of war offered them to suppress, once for all, that despised "service aéronautique." The seaplane mother ship *Foudre* was turned to other duties, and the few machines (14) and pilots then available lent to the army and to the English Navy. After the broadminded and enterprising British maritime authorities had demonstrated at Cuxhaven

and in the Dardanelles the scouting and offensive worth of flying machines, official attention was reluctantly turned to avions that had increased to 1100 by 1918, whilst over 60 aerial stations had been created along French coasts, but even then the French aviation maritime remained a purely defensive force in contrast with the larger and offensively-organized British seaplane fleet. On the morrow the war, Admiral Ronarch, the hero of Dixmude, who had got personally acquainted at Dunkirk with the possibilities of aerial bombardment, availed himself, with his ephemeral and mostly nominal powers as chef d'etat-major general, to place in hand an imposing aviation programme, comprising powerful machines of 500-horsepower and more designed for 12 hours' continuous flying and intended to eventually assure to France the aerial command of the Middle Sea. Instability, ill-will, and anarchy at the head, and consequent neglect on the part of red-tape officials have caused most of the avions he ordered to rot unused in harbor. Of the 60 seaplanes that were, in August last, to fly over the Mediterranean and back, hardly half a dozen have come up to expectations.

At the same time, a brighter outlook is opening for aviation under the present Ministry. While our naval aviators do not as yet receive the counterpart of the advantages and encouragements enjoyed by their British colleagues, they are no longer being systematically put down and overlooked at promotion time. Com. Lefranc, one of the best-known service airmen, has just been raised to the superior rank, and a similar reward awaits the several officers who have of late distinguished themselves by their flying exploits. The flying sport is being encouraged in the ports militaires, and also in the battle force by Admiral Charlier, who has just taken the effective command of the Mediterranean aerial force, and has announced his intention to test to the utmost the actual scouting and offensive capabilities of seaplanes, as well as of the few A. T. dirigibles placed at his disposal. Henceforth there are to be no fleet maneuvers without avions being at work overhead in their various rôles. Similar experiments on a perhaps larger scale are to take place in the Italian Navy, which is just now under the guidance of jeune école converts; tendencies which apparently justify the forecast of experienced naval men that a few years hence the mastodons will be definitely ousted from the Mediterranean and seek refuge in the vast and well-sheltered Atlantic roadstead of Brest. There are signs that time is working for aviation in gradually relegating to oblivion those retrograde bureaucratic officers responsible for the slow and unsatisfactory progress of the aerial branch, and in replacing them by new men imbued with new principles and alive to the capital fact that the art of war is not for a moment at a standstill, but perpetually modified by some novel innovation, and that true efficiency is made up of constant research and watchfulness and of quick decision.

The problem of the light, handy, and transportable fleet seaplane has been solved by our naval aviators. Swift Spads and Nieuports make the best "hydravions de chasse" in existence. With the co-operation of private industry, aerial dreadnoughts of over 40 meters span and 2500-horsepower will be added to the Landry programme for six scouts, 12 super-destroyers, and 12 super-submersibles of cruiser speed.—*The Naval and Military Record,* June 23, 1920.

GERMANY

A FUTURE ON THE WATER.—Recent events in Germany have given no encouragement to the pious hopes of a naval renascence expressed by Tirpitz, Scheer, and other distinguished members of the former "Kaiserliche Marine." Admiral Hollweg, writing in one of the Hamburg journals, paints a gloomy picture of the future of German sea power. Herr Noske, the late Minister of Defence, made intelligent and purposeful endeavor to save from the ruins of the old navy the best of its experience and traditions, in

order to apply them to the building up of a small but efficient fleet, but according to Admiral Hollweg the effort has been a failure. For the past year a number of the best officers have been giving loyal and devoted service to this end, but without the least success. "Discipline and obedience were indispensable elements in this work of reconstruction, but both have been wanting. Thanks to the demoralizing influence of the seamen's federations, the personnel failed at the first test. The entirely correct attitude of the Commander-in-Chief at Wilhelmshaven availed nothing; the men's confidence in their officers was undermined by agitation, and the Kapp 'Putsch' brought matters to a head." It is a pity that the admiral is not more explicit on this point. What he says suggests that the sailors feared that they might be made the tools of a Monarchist coup, and promptly took measures to avert any such danger. Be this as it may, Admiral Hollweg regards as quite hopeless any further attempt to create a new navy out of the existing material, and he asserts that an overwhelming majority of the officers are resolved to have nothing more to do with a "pseudo-navy run on trade union lines and administered by Soviets." Here and there, he admits, an officer may be found willing, for opportunist reasons, to subordinate himself to the Soviets; but "such officers will not be of the best type; they will simply be mercenaries and parasites." The Soviets insist that all executive positions shall be filled by warrant and petty officers, a scheme which the admiral denounces as Utopian. "Should it materialize, there will be constant friction, for every seaman will want to be an officer."

Since both Kiel and Wilhelmshaven are hot-beds of revolution, Admiral Hollweg proposes that they be abandoned as naval bases and that the navy, as it now exists, be entirely disbanded. "It is a grave and difficult decision, but there is no alternative. It means more than the temporary renunciation even of a small navy; it seals Germany's fate as a nation cut off from any share in sea power, either military or economic. England's victory is absolute. It seems the special fate of navies to disappear amidst revolutionary upheavals. England alone, with her instinct for the sea, has known how to avoid such a disaster in these troubled times."

There is, he considers, only one way of preserving for Germany a modest share of sea power: an entirely new fleet of small dimensions must be built at a new base, such as Pillau, Swinemünde, or Stralsund, where its personnel would be far removed from the revolutionary atmosphere prevailing at Kiel and Wilhelmshaven. In the new navy politics would be entirely barred and the Soviet influence excluded; discipline, obedience, and loyalty to the Constitution would be the ruling principles. To ensure the success of the plan it would be necessary to appoint some distinguished officer to the head of affairs, and Admiral Scheer is suggested as the best candidate. It remains to be seen whether Admiral Hollweg's scheme will find any substantial support. From all accounts the nation at large has lost interest in the sea and everything pertaining thereto, and is determined to apply what energy and resources it still commands to the re-establishment of national industry and trade. Consequently, unless some wholly unforeseen development occurs, there is little prospect of a new German fleet coming into existence within the next few years.

In common with Tirpitz and Scheer, Admiral Hollweg appears to throw the entire blame for the old navy's collapse on to the shoulders of lower-deck "politicians" and "sea lawyers." But in justice to the German seamen it must be remembered that they were only following the example set by many of their officers, from Grand Admiral von Tirpitz downward. Politics seemed, in fact, to be the sole hobby of 90 per cent of these officers. They took a prominent part in the Press agitation which contributed so much to the embitterment of Anglo-German relations; they ardently supported those political factions which were working for war, and the Admiralty Press Bureau continued for years to issue a steady stream of violently partisan literature. Nor can naval officers disclaim responsibility for

the class hatred from the effects of which they are now suffering. It was often said in pre-war days that the wardroom of a German warship was more exclusive than the Court of Austria. The engineer officers were treated as social inferiors with whom it was derogatory to associate except in purely service affairs. Few executive officers displayed the least sympathy with or understanding of the lower deck, and we know from subsequent revelations that this ultra-aristocratic exclusiveness continued right through the war. In the manifesto published by the revolutionaries at Kiel the officers were charged with having lived like fighting-cocks while their men were on half-rations, and Captain Persius is not the only witness who corroborates that charge.

Labor troubles and shortage of material, but especially the former, are still imposing a heavy handicap on the German shipbuilding industry. There have been three lock-outs at the Schichau yards in Danzig and Elbing during the last eighteen months, and, although work is now in progress there, the firm still complains of its inability to fulfil contracts owing to the low rate of production. After months of bickering with its many thousand employees, the big Blohm and Voss concern at Hamburg has closed down, and is threatening to make the lock-out permanent unless the workmen promptly come to terms. Meanwhile the papers bemoan the ruin that threatens German industry if the Allies persist with their demand for the surrender of tonnage. They declare that the 300,000 gross tons of shipping still remaining in Germany will not suffice even for the carriage of the iron ore which is urgently needed; that East Prussia, now cut off from the Fatherland by the "Danzig corridor," requires large quantities of war material and foodstuffs which can only be carried by sea, and not a single ship is available for the purpose. "Notwithstanding these facts," says 'Schiffbau,' "the Entente demands the handing over, under the peace terms, of half the total number of vessels between 1,000 and 1600 tons gross, a demand that is incomprehensible considering that the Entente at the same time insists on the reconstruction of the devastated territory in Belgium and France, besides the fulfilment of all other conditions of reparation. Instead of making it possible for Germany to furnish her industry with raw materials and her population with food and work by allowing her to keep these ships, the Entente is adopting the contrary course, and thus putting it out of her power to fulfil her various obligations." One of the largest ironworks in north Germany has issued the following statement: "The confiscation of our remaining ships will probably compel us to close down, since they are now the only means we have of importing raw material. Foreign tonnage is much too expensive, and is not to be had. Our works can continue open only so long as they are fed from the sea. The effects of confiscation on the north German iron industry—the main source of supply—will be simply incalculable." In a word, Germany begins to experience the first effects of the world-wide shipping famine caused by her mad orgy of submarine ruthlessness. She is also beginning to realize that the loser pays, and evidently finds the process a painful one.—*The Naval and Military Record,* May 26, 1920.

GREAT BRITAIN

BRITISH NAVY ESTIMATES

STATEMENT OF THE FIRST LORD OF THE ADMIRALTY.—An analysis of the gross expenditure of £96,490,181 estimated to be incurred in 1920-21, shows that it can be approximately divided into:

(a)	Non-recurrent war liabilities or terminal charges.........	£19,077,000
(b)	Recurrent expenditure due to war conditions, *e. g.,* increases in prices and in rates of wages, pensions, etc., and separation allowance	40,023,200
(c)	Normal expenditure on basis of pre-war rates and prices..	37,489,981

On this basis, the following comparison of the gross estimate for 1914-15 with the gross estimate for 1920-21 can be made:

1914-1915		1920-1921		
Gross estimate	£53,573,261	Gross estimate		£96,590,181
Deduct amount included for new construction	18,373,000	Deduct war liabilities including new construction	£19,077,000	
		Deduct recurrent expenditure due to war conditions	40,023,200	
				59,100,200
	£35,200,261			£37,489,981

The increase of approximately £2,290,000 over the provision required in 1914-15 is due mainly to the following causes:

The grant of clothing allowances to men of the fleet.
Provision of larger hospital ships.
The extension of scientific research and of technical training.
Reduction in the hours worked by the industrial staff.
Increase in non-effective charges.

The number that we propose shall be voted in Vote A for the maximum number of the personnel of the fleet to be borne on any day during the financial year, is 136,000 as compared with 151,000 in 1914-15. The numbers at the date of the armistice were 407,316, and by November, 1919, had been reduced to 157,000. The actual number required for the reduced fleet which it is proposed to maintain during the year is 127,500; but the provision under Vote 1 for the pay of the fleet has been based on the assumption that 131,000 officers and men will still be borne at the end of the year, as it cannot be expected that all those who are surplus to our reduced requirements can be disposed of during 1920-21.

There is great difficulty in suddenly effecting large decreases or increases in naval personnel, and the reduction of over 25,000 officers and men in the 17 months from last November to April 1921 will, if accomplished as we hope, be a remarkable feat. It must be remembered that the crew of a ship is made up of numerous small groups of individuals of many trades—gunnery ratings, torpedo ratings, engine-room ratings, signal ratings, electricians, armorers, mechanics of many kinds, and so on, each group possessing entirely distinct qualifications and having an entirely distinct duty, but each absolutely essential to the fighting efficiency of the ship. In every adjustment of naval personnel, provision has to be made for each of these numerous branches of skilled men to be kept up to strength in every ship all over the world; any attempt to wash out naval personnel with a broad brush at once immobilizes far more units of the fleet than was ever intended.

The time is opportune for an explanation of some of the principal decisions which the Board of Admiralty have taken, and of the motives by which they have been guided, while framing these estimates which may perhaps be described (in spite of the considerable provisions for war commitments which they embody) as the first of the new series of peace estimates. I therefore append some notes on naval policy, and a note on dockyard policy. It should be understood that these statements do not purport to be exhaustive even of the decisions already taken, still less of the matters which are engaging the attention of the Board.

NOTES ON NAVAL POLICY.—(*a*) *General Remarks:* 1. During the past year it has not been possible to frame a definite statement on naval policy owing to the changing situation, the necessity for keeping the fleet pre-

pared for eventualities during the armistice period, and the active operations imposed on the navy in the Baltic.

2. It is now possible to estimate more clearly and closely what are the requirements of the future, and to make what it is hoped will be regarded as a fairly full statement of our naval commitments and proposals.

3. Since sea power is essential for the security and prosperity of the British Empire, it is the object of the Board of Admiralty to proceed on lines which they believe will provide us with our vital requirements and at the same time secure the exercise of rigid economy. The expenditure necessary for such a policy is merely an insurance of our existance, and a guarantee of our increased prosperity.

4. In view of the vast efforts made during the years of war, it is possible for us to-day to suspend production for the time being and concentrate largely on assimilating the lessons of the war, the fleet being reduced to minimum requirements as regards both personnel and matériel.

The organization of the fleet as shown in Appendix I represents these minimum requirements.

5. In the first place we have certain definite duties to perform in support of allied policy, and to assist in stabilizing the disturbed conditions which at present prevail in the world.

We have also to provide the units necessary for maintaining adequate sea-going training for our personnel.

We have to station small cruiser squadrons on foreign stations, North and South Atlantic, Pacific, Indian, China, and Australian waters to assist our trade and support the needs of the Empire.

Finally, we have to meet the requirements of technical training to ensure progress in modern devices and methods of warfare.

(*b*) *Strength of the Sea-Going Fleet.*—6. We have based in home waters our main fleet, the Atlantic Fleet, consisting of 1 fleet flagship, 2 battle squadrons together comprising 9 ships, a battle cruiser squadron of 4 ships, one of which is conveying His Royal Highness the Prince of Wales on his tour of the Dominions, 2 light cruiser squadrons, 4 destroyer flotillas and attendant vessels. This is the least number of units to ensure progressive tactical and sea training. A lesser number would destroy the possibility of exercises at sea under realistic conditions; the tactical units would be reduced to such an extent that the problems of gunnery concentration, fleet torpedo tactics, destroyer attacks, anti-submarine tactics could not be studied and practiced; the sea training of officers and men would suffer, and progress would cease. To have one fleet in which the lessons of the war can continually be practiced and new tactical methods devised has been one of our principal objects in maintaining that the Atlantic Fleet should be of the strength laid down.

7. In the Mediterranean we have stationed a squadron of 6 battleships, 1 light cruiser squadron, 1 destroyer flotilla and attendant vessels. This moderately strong force is, in our opinion, necessary to meet political conditions in the near East. That this force is not excessive is shown by the fact that it has recently been necessary to detach a squadron from the main, or Atlantic, fleet to the Levant, the Mediterranean Fleet being fully employed on other important duties, and unable to meet all the demands made upon it.

8. As regards the squadrons on the China, African, North and South American and East Indies stations, the need for them, which has always been recognized in the past, has never been more urgent than it is to-day, in view of the necessity for re-establishing the internal trade of the Empire, and promoting that with foreign countries. The navy constitutes that police of the seas, and all experience teaches that an efficient navy is the surest guarantee for peace.

(*c*) *Remarks on the Capital Ship.*—9. There has been some criticism of the maintenance in commission of the present types of vessels, especially

in regard to the capital ship. A contrary policy has been openly advocated, this policy being based, it is presumed, on the idea that the battleship is dead and that submersible and air vessels are the types of the future. The naval staff has examined this question with extreme care, and as a result we profoundly dissent from these views.

10. In our opinion the capital ship remains the unit on which sea power is built up.

So far from the late war having shown that the capital ship is doomed, it has on the contrary proved the necessity for that type. On the German side the whole of the submarine campaign against merchant vessels was built up on the power of the high sea fleet. On the British side the enemy submarines in no way interfered with the movements of capital ships in carrying out operations; destroyer screens, new methods of attack and altered tactical movements defeated the submarine.

11. Not at present could the Board of Admiralty subscribe to the statement that aircraft have doomed the capital ship. Aircraft are certainly of the highest importance in naval tactics, as regards reconnaissance, torpedo attacks and artillery observation, but their rôle in present circumstances is that of an auxiliary and not of a substitute for the capital ship. The past history of this question must be taken into account; many times has the doom of the battleship been pronounced. The introduction of torpedo craft was believed in certain quarters over 20 years ago to have settled its fate. The Board of Admiralty at the time refused to be carried away by the attractiveness of the idea of building small, cheap torpedo craft instead of battleships, and they proved to be right. History has shown that the introduction of a type to destroy the capital ship has been quickly followed by the evolution of counter-measures which sustain its power.

12. We therefore believe that the battleship must remain the principal unit, and that fleet tactics and tactical training must be carried out with the battle squadron as the main unit. Nevertheless, it must be emphasized that although the battleship remains, its type may require to be altered. Advances in electricity, in the internal combustion engine and in science generally will inevitably necessitate an eventual change of type, and it is one of the principal functions of the Naval Staff to keep continuous watch on scientific development, with the object of ensuring that the type of capital ship designed meets the requirements of the future. It is even possible that the present battleship will change to one of a semi-submersible type, or even of a flying type, but such types are visions of the far future, not practical propositions of the moment. By gradual evolution and development the types forecasted may arrive, but the immediate abandonment of the capital ship in favor of a visionary scheme of aircraft and submarines would leave the British nation destitute of sea power and without the means of progressive training.

(*d*) *Harbor Establishments.*—13. There remains to be considered that part of our fleet organization which deals with harbor establishments. The advance which was made in naval technical science during the war was very great.

Before the war we had no efficient mines, and instruction in mining was neglected; there was no system of minesweeping or of protection against mines as we now understand it; the various methods of submarine searching and attack had not been explored; the torpedo as a weapon was unreliable. The reason for this unsatisfactory state of affairs it is unnecessary to consider in this statement, but war experience has shown conclusively that if in times of peace we neglect development of these devices and instruction in their use, years of effort and vast expenditure are required to make good that neglect.

14. As a consequence, therefore, while it is desirable that we should keep down to bare minimum requirements the size of the sea-going fleets, it is essential that the navy should possess all information concerning the

latest scientific devices and their use; that in the event of war the sea-going fleet should be equipped with the best weapons modern science can provide; that there should be a personnel fully trained in technical science, and that the arrangements should be such that rapid expansion can take place both in equipping the reserve fleet and auxiliary units, and in training the reserve personnel for manning these units. For this purpose it is necessary to provide

(a) Adequate experimental establishments for the development of the latest scientific devices in accordance with the requirements of the Staff.

(b) Training establishments where the personnel will be fully instructed in the same.

(c) Light cruisers, destroyers and other attendant craft for carrying out practical experiments with the devices developed by the scientific establishments and for giving practical instruction in their use to the personnel.

(*e*) *Scientific Research.*—15. The organization of scientific research within the navy which has been set up so as to ensure that the latest developments are understood by the naval service, and that development both in types of vessels and in weapons will keep pace with scientific progress, is given in Appendix II to this memorandum. Under the Controller of the Navy there has been set up a department of scientific research and experiment. As the scientific adviser of the controller, and in charge of this department, there has been appointed a director of scientific research who is responsible for the general direction and organization of research work for naval purposes, keeping the navy in touch with outside scientific establishments, and ensuring that the work at the various naval experimental establishments dealing with mining, sound signalling and navigational appliances proceeds with full cognizance of scientific progress and methods. He will arrange for additional scientific assistance being given to these establishments as requisite. Further, the director of scientific research, by keeping in close association with the Naval Staff, will ensure that we are kept fully aware of the possible practical application of scientific progress in relation to naval needs, thus enabling us to formulate requirements as to types and weapons with a knowledge of the latest scientific possibilities, and to make ourselves better equipped for dealing with the vital problems of naval material development.

16. Consultations with outside institutions will be resorted to; so as to gain the benefit of their research and experiments, but there are some problems which it will not be possible to deal with in this manner, owing to their secret or to their special naval aspect. Special naval problems will be dealt with by the naval establishments—gunnery, torpedo, mining, signalling and anti-submarine—but for research work and secret development it is essential that the naval service should have a small central establishment of its own, independent of the special experimental establishments. Such an establishment was formed during the war at Shandon, and has performed, and is performing, good service. But Shandon is expensive to the country in its upkeep, and suffers from dissadvantage in position both in regard to its distance from the naval ports and from the Admiralty, with the consequent liability that owing to insufficient co-operation and contact with naval thought, the research work may be conducted without the necessary consideration for practical requirements.

17. It has been decided, therefore, to close Shandon as soon as suitable accommodation can be provided elsewhere. Such work at Shandon as requires sea environment will be removed to existing naval establishments. All pure research work now being carried out at Shandon will eventually be transferred to a small naval institute adjoining the National Physical Laboratory at Teddington. This institute, under the director of scientific research, will be entirely controlled by the Admiralty, but its close association with the National Physical Laboratory will offer exceptional facilities for co-operation, and the scientific staff of the institute will have the

advantage of personal acquaintance with the work being carried out in the laboratory. It is hoped to have this establishment ready at the end of the present year; meanwhile Shandon, on a reduced scale, is being kept going until the establishment at Teddington is ready. To stop pure research work altogether at this moment would be a retrograde step, and might conceivably have a serious effect ultimately on development of types and weapons, and on economy generally.

(f) *Technical Training.*—18. For the technical training of the personnel special schools are established at the naval ports of Portsmouth, Devonport and Chatham. The schools at Portsmouth are the largest, and attached to each of these schools is an experimental establishment dealing with the work of the school. This general system was in existence prior to the war, except that the experimental establishments were practically non-existent. As a result of the war, however, and of the progress in scientific and technical thought, large increases became necessary, especially in the establishments at Portsmouth.

19. As already stated, mining was considered in pre-war days to be a minor and unimportant branch of naval warfare; the staff dealing with this subject was small, and was attached to the torpedo school.

The utility of mines was emphasized early in the operations of 1914, and the science of mining gradually assumed a position of extreme importance in naval strategy and tactics. On the tactical side as well as on the scientific and material side immense strides were made. This called for staff and technical knowledge of the highest order, and necessitated the setting up of a special mining school at the Gunwharf, Portsmouth. This school, though it started late in the war, finally achieved great results, both on its experimental and instructional side. It is essential to keep this school in being.

The mining school at Portsmouth represents an additional establishment for which there was previously no provision. At this school the personnel will be instructed in the science of offensive and defensive mining, and also in devices for protection against mines, including the Paravane.

20. Apart from mining, the torpedo and electrical, and signal schools have all had to be expanded to meet modern requirements. The war was responsible for tremendous developments, and all these developments have necessitated more advanced instruction for the personnel, and an increased staff to give this instruction. More highly organized scientific and experimental establishments have to be attached to the schools.

21. Another technical branch of the naval service, which did not exist when the war was commenced, is the anti-submarine school; the importance of this school in the future can hardly be over-estimated. We have seen the great effort which was made by means of the submarine to wrest from us our sea supremacy. Science alone can give us the antidote to the submarine, and we have taken steps, as will be seen in the detailed statement regarding the fleet, to ensure progress in experimental work and training. Development in this work will undoubtedly be required to meet the possibilities of the future, and proposals are under consideration for the establishment of a school of anti-submarine work in conjunction with an anti-submarine experimental station.

22. The submarine training establishments themselves have, as a result of the war, become more, rather than less, important. Future developments in the submarine may have a profound effect on naval strategy and tactics. This subject is receiving continuous attention. Experimental work is being pressed forward, and in addition adequate steps are being taken to ensure that the high standard of the submarine personnel is maintained. The necessary staff and the attendant vessels shown in Appendix I have been allotted with this purpose in view.

23. It must be emphasized here that the policy with regard to instructional establishments generally has been to ensure the provision of an

adequate experimental and instructional staff, and of the appliances and sea-going tenders required for carrying out the experimental and instructional work with efficiency.

(*g*) *Personnel*.—24. It is upon the efficiency of the personnel that everything finally depends, and the Board of Admiralty are taking such steps as will ensure a naval service carrying on the traditions of the past, highly trained in staff and technical work, and will continue to do all in their power to secure conditions which will combine efficiency and contentment.

(*h*) *Entry and Training of Officers*.—25. First, as regards the officer personnel, it is proposed to adhere to the system known as the common entry system, by which is meant that the main body of deck officers and engineering officers will be trained in the same cadet establishment. The common entry system was the system introduced by the Board of Admiralty in 1903, but since its inception it has undergone many modifications, and in explanation of the present policy it is desirable to give in brief outline the existing state of affairs.

26. Whereas in the past there have been two colleges for the training of naval cadets, it is now proposed that there be only one college at Dartmouth, and that the Osborne establishment shall be closed.

One college is capable of dealing with the reduced number of cadets required for the present fleet, and economy will result from the change.

27. The age of entry for naval cadets under the common entry system will be between 13½ and 14. Consideration has been given to the question of entering boys at a later age, but it has been decided to adhere to the present age as being that at which the majority of boys finish their private school education, before proceeding to public schools.

These boys will go to Dartmouth College, which will in effect be the naval public school where general education on naval lines will be continued under a system of education somewhat changed from that under which the common entry system has hitherto been conducted in that more attention will be paid to general education, and the large amount of time which was previously devoted to engineering will be reduced. The important factor at the cadet college is to ensure that the boys have a thorough groundwork on which to build.

28. The cadets will spend four years at Dartmouth and will then be sent for two terms (8 months) to a training battleship for their practical education and for gaining acquaintance with sea life, afterwards being drafted to sea as midshipmen. As midshipmen they will take their part as officers of the ship to which they are appointed, but their instruction will continue, the majority of their time being spent on their work as deck officers and one-eighth being devoted to engineering.

After one year at sea, those midshipmen who show a special aptitude and liking for engineering will be permitted to volunteer for that branch of the service; such midshipmen will thereafter devote one-third of their time instead of one-eighth, as hitherto, to engineering.

29. On reaching the rank of sub-lieutenant a further opportunity will be given to officers to volunteer for the engineering branch of the service, and from these volunteers and from those who volunteered as midshipmen selections will be made. It may be expected that the majority of officers selected will be from those who volunteer for engineering after serving one year at sea as midshipmen, and who since that time will have devoted a considerable portion of their time to engineering studies.

Officers selected for the engineering branch when sub-lieutenants will, after going through advanced courses of engineering, be definitely placed on the engineering side of the profession, and will not revert during the remainder of their career to deck duties. They will rise through the various ranks of the engineering branch, with special rates of pay. Higher positions of administrative importance and responsibility at sea, at the Admiralty, and in the dockyards will be open to them.

30. It requires to be emphasized that officers selected at this early age will devote the remainder of their career to engineering. It is essential that the majority of officers forming the engineering branch should be "whole time" officers. There is a definite distinction, both as regards knowledge and capabilities, between those who are to be trained in the science of naval war and strategical and tactical methods of fighting, and those who are to deal with the upkeep and maintenance of engineering and mechanical appliances which are necessitated by the complex machinery and weapons of modern war. Each side requires a special study, and for this reason final separation of the branches is essential.

31. At the same time, although there must be this definite division between the deck and the engineer officers, each being charged with their own important sphere of responsibility, nevertheless, each branch must understand and sympathize with the requirements of the other. In the exercise of strategy and tactics it is necessary that there should be full understanding of the engineering and mechanical possibilities and difficulties, and how such difficulties can be overcome. On the engineering side it is equally necessary that there should be an understanding of the requirements of the strategist and tactician, in order that so far as practicable his requirements may be met and perhaps anticipated.

By means of the Common Entry System and training under a similar system until about the age of 20, when the rank of commissioned officer is reached, it is believed that this sympathy and understanding between deck and engineer officers will be fully and completely obtained.

32. At present there is a further scheme whereby officers, after one year at sea as lieutenant, are eligible to specialize in engineering in the same way as officers specialize in gunnery, torpedo and navigation.

After from 6½ to 8 years' service as specialists these officers may elect to revert to deck duties and will be considered for promotion with other deck officers. The efficiency of this scheme, and the necessity for its continuance, is now under consideration, and will be decided without prejudice to officers already specialized under its provisions.

33. Briefly, therefore, the system of general training as an officer will be:

(a) Common Entry System at about 13½ years of age.

(b) Three years eight months (11 terms) training at Dartmouth.

(c) Eight months in a training battleship.

(d) About 2½ years at sea as midshipman before becoming a sub-lieutenant.

(e) Midshipmen, after one year at sea, to be permitted to volunteer for engineering and to be given special engineering instruction.

(f) Sub-lieutenants to be permitted to specialize in engineering; officers selected to be turned over to the engineering branch, and to stay for the remainder of their career in that branch.

(g) Promotion to lieutenant after serving about one year as sub-lieutenant, that is about the age of 22.

(h) Lieutenants, after one year to be permitted to specialize in engineering, such lieutenants to remain from 6½ to 8 years in the engineering branch, and then to be permitted to return to the deck branch or to remain in the engineering branch. (Continuance now under consideration.)

(i) Promotion to lieutenant commander after 8 years as lieutenant, about the age of 30. Further promotion at approximately the ages and seniorities hitherto customary.

34. Although, as explained in the foregoing, it is the intention that the general age of entry shall be about 13½ years, and that boys so entered shall be sent to Dartmouth, it is highly desirable in the interests of the naval service that there shall be a special form of entry at a later age, so that boys who are not ready at the age of 13½ may still have an opportunity of entering the naval service, and also so as to allow of a certain number of public school and other boys coming into the service, and thus keeping

the navy in touch with the general educational system of the country. To permit of this, it has been decided to continue what is known as the Special Entry System, that is, a competitive examination between the ages of 17½ and 18½.

35. About 15 Special Entry cadets will be taken under existing circumstances annually; these cadets who will already have received a general education, will be drafted to a cruiser training establishment, there to learn the special subjects required, and to gain an understanding of the sea. After one year in the training cruiser these cadets will be sent to sea as midshipmen, joining up with the Common Entry midshipmen, and thereafter being trained on exactly similar lines. Their time of service as midshipmen will be adjusted so that on reaching the rank of lieutenant, Special Entry cadets will as a whole be not more than one year older than those entered through Dartmouth College. This year's difference in age will make little or no difference to an officer showing zeal and ability; promotion to the rank of commander and captain being by selection, this year can be more than made good, and, in respect of a subsequent career, boys who enter under special entry conditions should understand that they suffer no disadvantage as compared with those entering through the main channel.

(*j*) *Promotion from the Lower Deck*.—45. The foregoing gives the general system under which deck and engineer officers for His Majesty's service will be entered and trained. There remains to be considered the system of promotion from the lower deck, which is being devised to ensure that men who display conspicuous character and ability shall have the opportunity of reaching the highest ranks of the service.

46. At present, under the regulations of the special entry examination, a man from the lower deck between the ages of 17½ and 18½ can sit for this examination, and, if successful, he will become one of the special entry cadets in the ordinary course of events. But owing to the lack of early educational facilities and also to the specialized training received since joining the naval service, as boys, to the detriment of their education in such examination subjects as French and Latin, it is certain that only a small percentage of men could possibly take advantage of the special entry system. Some other system, therefore, than the special entry system must be looked to in order to give the lower deck of the navy the opportunity of reaching high rank, and to enable us to draw a proportion of officers from those who entered as boys on lower deck.

47. The present "mate system," whereby selected petty officers, provided they have seven years' service, are promoted and receive commissions as mates, and after a series of examinations and further service of two years become lieutenants, was designed to form an avenue of promotion from the lower deck, to the commissioned ranks. Many admirable officers have been produced in this manner. But the mate system has suffered from the disadvantage that, owing to the operation of the seven years' service rule, the majority of men promoted to commissioned rank in this manner do not reach the rank of lieutenant until 28-29 years of age or even later. When it is considered that an officer entering under normal conditions reaches the rank of lieutenant at about 22 years of age, it will be seen that under this system there is little chance of a man promoted from mate reaching a higher rank than lieutenant commander.

48. To remedy this state of affairs, and to give a real opportunity to all men, a certain number of vacancies in each year will be available for men from the lower deck who may wish to become officers.

A man on reaching the age of 21, provided he has satisfied the requirements of a Sea Selection Board and has passed the seamanship examination for officer's rank, and has further taken a first-class certificate in the special educational test, embracing mechanics, geometry, history, physics, and general subjects, will be eligible for selection before an Admiralty Selection Board. Those selected to fill the vacancies available will become

acting mates, the earliest age being 21. Provided a man takes a first-class certificate in the further special course he will undergo, he can become a lieutenant at the age of 23. Candidates who take lower class certificates will be required to serve a longer period at sea before promotion to lieutenant, the same procedure being followed in this respect as with Dartmouth College or special entry officers passing for lieutenant.

49. A man, therefore, who takes a first-class certificate, can be promoted to lieutenant at about the same age as a special entry cadet can reach that rank. He will then be on a precisely similar footing to other lieutenants with regard to promotion, the highest ranks being within his reach.

50. In connection with this development of the mate system, it is intended that those candidates who have been selected shall go through a special course designed to inculcate into them the essential requirements of an officer—knowledge of discipline, maintenance of morale and capacity for command of men; hitherto, men promoted from the lower deck have not had such a course. War experience has certainly shown the necessity for it, and in this respect the navy cannot do better than adopt the methods so successfully practiced by the sister service, which, as explained by the Secretary of State for War, during the last months of the struggle produced 95 per cent of the officers for the army.

51. The above gives briefly in outline the proposals of the Board of Admiralty for ensuring that a proportion of the deck officers of the navy shall be drawn from the boys establishments and from those who have served on the lower deck. An analogous system is being applied to the engineering branch as well; it will ensure to all the opportunity which is their right, or reaching a high rank in His Majesty's service.

52. It is not, however, the intention to rest here; it is hoped in the future to make further proposals with the object of broadening the field of entry and of removing the restrictions which financial contributions impose upon the promising lad who may display the qualities necessary in an efficient naval officer.

(*k*) *University Training of Naval Officers.*—53. There remains to be considered the higher education of the officers of His Majesty's service. Before the war this education was almost entirely professional and technical. Officers in their sub-lieutenant's examination were required to pass examinations in various technical subjects. Later, they specialized in gunnery, torpedo, or navigation, and went to special schools for this purpose, where their higher technical education was completed.

54. The whole of this question of higher education has been carefully reviewed in the light of war experience, and it appears that though the former system gave a type of officer of high professional attainments, yet, in many respects, it has left considerable room for improvement, the nature of the courses being rather too strictly professional and technical. Consequently, in certain respects, the naval officer was at a disadvantage as compared with his contemporaries in other walks of life, who had had the advantage of a more general education, and had come into contact with all shades of thought up to a comparatively late age.

55. The effect of the war was, in the case of the younger officers, seriously to interfere with their actual general education at the Osborne and Dartmouth colleges prior to coming to sea, nor was it possible, in the case of a large number of officers, to arrange for the special courses prior to their becoming lieutenants. At the close of the war, therefore, these officers found themselves at a serious disadvantage; first, from the interruption of their general education, and, secondly, from the fact that they had been unable as sub-lieutenants to pass through the courses at Greenwich College and the various naval schools.

56. To remedy this state of affairs, the authorities at Cambridge University were approached. The university authorities showed the greatest sympathy and gave us the most generous assistance, and as a result all those officers who had their studies interrupted by the war are being given

a special course at Cambridge University. This course is designed to broaden the outlook on life and to bring officers into contact at an impressionable age with university thought and university ideas. It will not be until 1922 that all officers who had their studies interrupted will have been through Cambridge; meanwhile, we are convinced of the enormous benefit which has already resulted to those officers who have been through the course. We are grateful in the extreme for the help which has been given; it has shown the value to the navy of this contact with the university, and it would be a profound mistake if this contact ceased so soon as the officers concerned have passed through their courses.

57. It is in contemplation to frame a scheme subject to the concurrence of the university authorities, under which in the future a university course will be an integral part of training for about 25 per cent of the sub-lieutenants in each year. It is considered that about this percentage will gain real and lasting benefit from the course.

58. The full details of this scheme of training will be worked out during the coming months. Broadly, the proposals are that all sub-lieutenants shall undergo, in addition to the technical courses of gunnery, torpedo, pilotage, and navigation, a special course of mathematics and physics, and an elementary war course at Greenwich. In this elementary war course, to which great importance is attached, sub-lieutenants will be given an introduction to strategy, tactics and the study of war. After Greenwich 25 per cent will be selected for the special university course, the remainder passing to sea-going ships prior to promotion to lieutenant.

(*l*) *Staff Training*.—59. In the interests of the future of the service, great importance attaches to the selection and training of officers for the War Staff. A body of officers is required who have made special study of the lessons of history and of the war, and who are capable of sifting and applying the mass of evidence available.

60. Reduction of the navy to the utmost limit in ships and material makes it the more important that the efficiency of the War Staff shall be of the highest order, and that during the forthcoming years there shall be passed through the Staff College a number of young officers whose training in staff work will ensure a common doctrine on strategical and tactical questions, the right application of the lessons of the past, and the ability to foresee the requirements of the future.

61. With this end in view a Naval Staff College has been set up at Greenwich. The first course commenced in June last and will be completed in June of the present year. In the next course commencing in September, the number of officers will be increased and will, it is hoped, include representatives from the Dominions.

62. We must aim at training at least 40 naval officers a year, so that in 10 years 400 will have qualified for the Naval Staff and will be distributed through the various grades of the naval service. It is further highly desirable that the number of army, air force, and Dominion representatives attending the Naval Staff College should be increased to ensure close cooperation between the services, and to build up the naval thought of the Empire on the common doctrine on which the navy must prepare itself. To carry this out it will be necessary to consider methods of increasing the Staff College accommodations; this matter is receiving serious attention, and it is hoped that a decision will be reached in time to enable the staff course in 1921 to be of the dimensions proposed; the matter will be referred to in the Naval Estimates of 1921-22.

63. For the benefit of senior officers who are unable to take advantage of the Staff Course, a War College has been opened at Greenwich and a special staff appointed for instructional purposes. Strategy, tactics, and command are the principal subjects dealt with. The course at the War College will be preceded by technical courses at Portsmouth dealing with the use of weapons and progress in weapon technique. The War College at Greenwich opened on 1st of March.

(m) War Staff Organization, Admiralty.—64. As it exists today the War Staff at the Admiralty, it is correct to say, is largely a war product. Before the war the Staff consisted of the Intelligence Division, Operations Division, and Mobilization Division. No "policy" or "planning" division had then come into being, and no division of the Staff dealt with the tactical side of naval war, types of ships, and use of weapons. The exigencies of war brought about an expansion of the Admiralty including the divisions dealing with the operations and requirements of war, and emphasized the need for separating operational worn on the one side from the work of administration and supply on the other. The reforms were carried out by the Admiralty under war conditions, and as a consequence certain logical divisions of duty in the Naval Staff organization could not be effected.

65. The main consideration on which we have worked in improving the Admiralty Staff organization has been to strengthen that side of the Staff which deals with the use and employment of weapons, the tactical questions consequent on change of weapons, types of vessels necessary to carry out naval policy, and staff questions dealing with scientific research and experiment. The staff view on these matters must be kept in the forefront, otherwise there is the danger that requirements of design and supply will dictate the principles relative to use and employment, resulting in the weapon become the master and not the servant of the tactician.

66. The war has enabled us to test the weapons forged during a century of peace, and has shown that some of them were unsuitable and inadequate. It is clear that the reason they were so was not so much the fault of the design or manufacture, as that the designers are now shown to have been incorrectly or incompletely advised as to the fighting requirements of the moment.

67. In order that progress in naval matériel may be steady, consistent, and well judged, and not impulsive and jerky, it must be based on continuous study and co-ordination of the lessons of war, and of experience and progress of our scattered fleets in their peace exercises and practices. The design of our ships must not and should not depend on the impulse of an individual nor merely on the mechanical possibilities of the moment, though the latter must necessarily limit the immediate accomplishment of our whole aim. Design must primarily depend on closely reasoned "requirements" based on evidence continuously and steadily accumulated from the lessons of our fleets, for whose use the ships and weapons are to be supplied. The aim must, and necessarily will, be provided by the science of the day.

68. The work thus indicated is the work of the Staff, and certain divisions of the Staff are therefore being grouped under the Assistant Chief of the Naval Staff to deal with questions relating to the use of weapons, types and designs to meet future developments, co-operation of aircraft and their employment in naval war, weapon technique and the introduction of new weapons. In fact, the Assistant Chief of the Naval Staff will be responsible under the Chief of the Naval Staff to the First Lord for dealing with all Staff questions affecting battle tactics and fighting efficiency.

69. The divisions of the Naval Staff dealing with operations, policy, intelligence, and training have been similarly placed under the Deputy Chief of the Naval Staff, the accepted principle of organization that current work and future work shall not be dealt with by the same division being closely adhered to. Under the operations division will come all those matters of current importance affecting the movements of ships and defence of ports, whilst the policy division will investigate future strategical questions, strengths of fleets, and development of dockyard and other facilities to meet future requirements, in accordance with the policy laid down by His Majesty's Government.

70. Briefly then the organization of the Naval Staff to meet peace requirements is as follows: At the head of the Naval Staff is the Chief of

the Naval Staff, responsible to the First Lord for the fighting efficiency of the fleet and the strategic and operational instructions to carry out policy. Under the Chief of the Naval Staff the Deputy Chief of the Naval Staff on the one side is responsible for operations, policy, intelligence, and training, and the Assistant Chief of the Naval Staff on the other side is responsible from the Staff side for the development and use of material, including types of vessels, weapons, and tactics.

71. Under this organization war experience will be fully laid to heart and the lessons applied to naval training and naval progress. Further, by these means the Staff is reduced to the minimum numbers compatible with efficiency, whilst at the same time rapid expansion on sound lines is allowed for in the event of emergency. From an organization consisting of ten divisions with a personnel of 340 the new organization will shortly consist of eight divisions with a personnel of about a quarter of that number. They should supply a sufficient personnel to study and apply the results of our experience, and by neglect of that experience there would be real danger of embarking on expenditure on wrong lines, the building of wrong types of vessels, incorrect tactics, and a faulty training of the personnel.

(n) War Staff Organisation: Sea Commands.—72. The War staffs in all sea-going commands and at the harbor establishments have been organized on similar principles, with reduced staffs according to the size of the command. As with the Admiralty Staff, it is correct to say that before the war the staffs at sea were only partially developed. There was a tendency for study of the technique of naval weapons to overshadow study of their employment.

73. War experience necessitated a change in these methods, and the division of staffs afloat into War Staff on the one side and a technical and administrative service on the other, is now an integral part of the organization of the navy. As trained War Staff officers are produced they will be appointed in their various capacities to fill the positions in those commands. By interchange between officers on the Admiralty Staff and the commands afloat, and also by arranging that Staff officers are appointed at intervals for general ship duties, leaving their staff work for the time being, it will be ensured that touch is kept between the Admiralty and sea thought and sea progress, and also that the Staff officers themselves do not become divorced from the general sea service, with a consequent narrowness of outlook unable to appreciate through lack of sea experience the various problems in connection with sea training and the personnel afloat.

74. With the system of training and organization of staffs on these lines, it is considered that the high efficiency of the officer personnel is ensured; that unity of thought and action will result from a common staff doctrine, and that the full requirements, present and future, will be met with the greatest efficiency and the greatest economy.

(o) The Navy and the Air.—75. We recognize fully that future naval policy is profoundly affected by possible developments in the air. All classes of aircraft employed as adjuncts to naval warfare have already shown the great effect they exercise in naval tactics and reconnaissance, and in combined operations. Looking ahead, it is possible to foresee tremendous developments in the air which may revolutionize eventually our present conception of sea warfare and sea strategy. But whilst giving the utmost consideration to the experience already gained, it is vital to this Empire that it should not be carried away by hasty proposals into the belief that air power is already a substitute for sea power. That day may come, but it is not at present in sight, and in the meantime to give way to these false ideas would be to throw ourselves open to grave peril and to leave ourselves without the means of exercising that influence in world affairs which the navy, as at present constituted, renders possible.

76. Nevertheless, our organization must be such as to enable us to take full advantage of the progress in aerial matters and to appreciate fully the effect of this progress on the art of naval warfare, and to utilize to

the utmost extent the combined effect of air power and sea power for the defence of the Empire and the control of our sea communications.

77. The new organization of the Admiralty Staff under the Assistant Chief of the Naval Staff is especially fitted for dealing with this vital matter. Arrangements have been made with the Air Ministry for close co-operation between the Admiralty Staff and the Air Staff, and for ensuring that the two staffs are conversant with each other's problems and requirements.

78. To remove all misconception it should be stated with emphasis that we in no way contemplate a return to a separate naval air service. It is recognized that the Air Ministry was created by Parliament as a result of war experience to further the development and maintenance of air power, and that to separate entirely from the Air Ministry that part dealing with the navy would be to retard progress and result in a weakening both in development of matériel and the training of an air personnel.

79. At the same time it is an essential accompaniment of the establishment of a separate Air Ministry that the functions of the two departments should be clearly defined, and more especially is this the case with regard to the responsibilities for the conduct of operations.

The Admiralty have represented to the Air Council, that, in their opinion—

(a) The operations of all aircraft flown from His Majesty's ships and vessels with whatever object in view, that is to say, not only reconnaissance and artillery observation machines, but also machines which are carrying out operations in the air for offensive and defensive purposes; and

(b) All operations carried out by aircraft not flown from ships, but which are being carried out in connection with the command of the sea, that is to say, operations for oversea reconnaissance and for the attack of enemy ships and vessels—

should be under naval control. Dual control would be unworkable. In all matters relating to the command of the sea the Admiralty are and remain the responsible authority.

80. We are working out the scheme outlined in the memorandum by the Chief of the Air Staff issued as Cd. 467, and are in correspondence with the Air Ministry with a view to putting it into effect.

So far as can be foreseen, naval requirements will be met by the proposal ultimately to form a naval wing under the Air Ministry, with a personnel specially trained for naval work.

81. To assist in the development of this naval wing, it is proposed to second officers volunteering for air work in the air service for training and for subsequent service in the naval wing. Such officers as are specially fitted for work in the higher ranks of the Air Service will, by arrangement with the Air Ministry, be permitted to continue in the Air Force, but the majority of officers after their term of service in the Air Force will return to the naval service and continue their naval duties. Thus in the course of a few years there will be a body of naval officers who will have had experience in the Air Service, who will be equipped with knowledge regarding air matters, and who will be able to keep the navy as a whole fully up-to-date in regard to air strategy and air tactics in relation to sea power.

82. Thus by seconding naval personnel to the Air Force, by an interchange of naval and Air Force officers between the Staff colleges, and by the special organization of the Naval Staff, the naval service will be prevented from falling behind in air matters through lack of foresight, through ignorance, or through a conservatism which refuses to understand the necessity of change consequent on development.

(q) *Miscellaneous Personnel Questions.*—(I) Officers of Accountant and Instructor Branches: 84. The committee which was appointed in July last, with wide powers of reference, to consider the position as regards the accountant branch is on the point of making its report. As soon as the report is received, the question of the future conditions of

service and scope of employment of the branch will be fully considered by the board.

85. The instructor branch, which was being allowed to die out before the war, is being reconstituted on a wider basis. The instructor officer is being made responsible for the general education arrangements afloat, apart from work of a purely professional character, both as regards junior officers and ratings. It is anticipated that, apart from the advantages of having an officer of special university training on board, naval education generally will derive benefit from the change.

(II) Welfare Committee: 86. A new experiment was made by the Admiralty last year in the shape of what is known as the welfare committee. Special facilities were given to enable full discussion to take place at the home ports on matters affecting the different branches of the service and the lower deck generally. Subsequently representatives elected by the men themselves were attached in an advisory capacity to a committee of officers, and a very large number of questions were brought forward and discussed at a series of meetings extending over several months. The report of the committee, which is very voluminous, was made on the 3d March. Any changes which are decided on after consideration of the report will be promulgated to the fleet in the usual manner. We attach great importance to the operations of this committee, and we hope that, with sympathetic consideration, they may lead to many improvements in matters affecting the well-being of the men.

The Board of Admiralty are much indebted to Admiral Sir Martyn Jerram for the care and sympathy with which he has presided over the deliberations of this committee, in continuation of the work he had previously done in connection with the pay of the lower deck.

(III) Sports and Recreations: 87. A special section has been set up at the Admiralty to supervise physical and recreational training in the service. It is also part of its duty to promote the organization of sports and games, and with this end in view a sports' control board has been set up at the Admiralty, and various sports associations and local sports committees have been formed.

(IV) Reserves: 88. The question of the naval reserves has not yet been finally dealt with.

A committee is considering alterations in the existing arrangements for enrollment, training and employment, and the organization for rapid expansion on the outbreak of war.

It is therefore not possible to make any announcement at present, but the importance of early decision is recognized and the matter will be pressed.

For the moment it may be sufficient to say that the reserves have fully proved their value during the war, and that it is intended to retaain them as part of our peace organization.

NOTE ON DOCKYARD POLICY.—The report of Lord Colwyn's committee on work in His Majesty's dockyards having been presented to Parliament, I take this opportunity of adding a few words in explanation of the present situation in the yards.

Before the war the home dockyards were six in number, viz., Portsmouth, Devonport, Chatham, Pembroke, Sheerness and Haulbowline, and the number of men employed on shipbuilding and repair work was about 42,000.

We now have seven home dockyards, the great and finely-equipped dockyard of Rosyth having been completed during the war.

The number of men employed on shipbuilding and repair work in the home yards at the time of the armistice was 67,800.

This great increase was necessary in order to deal with the urgent repairs of the fleet, which had to be carried on practically continuously day and night, by means of double shifts, etc.

The increase was mostly in the engineering trades and in semi-skilled and unskilled labor, and these classes at the time of the armistice were necessarily out of proportion to the numbers of shipwrights and allied trades.

In the months immediately succeeding the armistice, a large amount of urgent work, in fitting out ships for their foreign stations and in connection with the reconditioning of mercantile vessels temporarily added to the navy during the war, devolved upon the dockyards and kept practically all hands employed.

When this work began to fall off, it became necessary to consider the reduction of dockyard numbers to a normal peace establishment, in fixing which the effect of the existence of the new yard at Rosyth in drawing away work from the southern yards had of course to be allowed for.

It was decided to effect the necessary reduction in numbers as gradually as possible by a system of regular weekly discharges, preceded by a fortnight's notice, so as to enable men to get employment in the merchant shipbuilding yards, where the need for additional labor was stated to be urgent. Experience soon showed however, that the merchant shipbuilding yards only absorbed a small number of the men so discharged. This was largely due to the impossibility of finding married accommodation in the commercial shipbuilding centers, but partly also to the fact that the surplus dockyard men belonged chiefly to the engineering trades and to semi-skilled and unskilled classes, whereas the urgent demand in the merchant shipbuilding yards is for shipwrights and allied trades. Considerable numbers of shipwrights who could ill be spared from the dockyards were set free in the autumn so as to relieve the shortage in the merchant shipbuilding yards, but this was done at a cost of still further disarranging the proper balance of trades in the dockyards, and has added to our difficulties.

In these circumstances His Majesty's Government decided that the discharges from the dockyards should be reduced to a minimum during the winter, and naval work that was originally intended to be deferred until a later date was brought forward, so as to keep as large a number as possible employed during the winter months.

Simultaneously, the committee, under the chairmanship of Lord Colwyn, was set up to advise on other ways of tiding over the emergency, and has made the valuable report which has recently been laid on the table.

In pursuance of the recommendations of the committee, the Admiralty are taking steps to lay down an oil tanker at Devonport immediately, and a second mercantile ship will be laid down at Pembroke at a very early date. It has been decided, in view of the difficulties of the present situation, not to proceed further with the proposal to lease the latter yard. There is no slip at present available at Portsmouth, and one will not become available there until late in the year, but the question whether a dock could be utilized at an earlier date for laying down a third mercantile ship is under consideration. A slip is available at Chatham, but the amount of urgent naval repair work employing shipwrights is so large, and the disproportion of trades is so great, that we could not at present start a merchant vessel there without drawing away shipwrights from the commercial yards, a procedure which would not be in the interests of merchant shipbuilding at the present time. Any further opportunities, however, of taking in hand work such as is contemplated in the committee's report will be carefully watched for and utilized.

Whilst these measures will undoubtedly mitigate to some extent the severity of the reductions that will have to be reintroduced after the end of this month, I wish to make it clear that, in spite of all that has been done and all that can be done, very heavy discharges will have to be made during the year 1920-21. After the most careful consideration the Board are unable to suggest any alternative means of at once meeting the pressing demand for public economy and remedying the serious disproportion of trades in the dockyards.

In the concluding paragraphs of the preceding statement on naval policy, I have made it quite clear that, in the interests of public economy, the Board are keeping down naval repair work and other dockyard services to as low a figure as is possible during 1920-21. It will, of course, be pointed out to me that the effect of this policy of economy is to increase the discharges during the same period. It is perfectly true that there is the possible alternative of spending a great deal more money in the dockyards that in this way we could make it necessary to employ more men. But to resort once more to this process of bringing forward work which would otherwise fall on a later year could only prolong for a short time the maintenance of the present abnormal conditions in the dockyards, and would necessarily be followed by an even greater and more sudden reduction in numbers, at a time, probably, when the present intense activity in commercial shipbuilding will have abated, and when consequently the difficulties of absorption in outside industry would be increased.

APPENDIX I

Fleet Organization

ATLANTIC FLEET

Fleet Flagship	*Queen Elizabeth.*
1st Battle Squadron	*Revenge* (flagship). *Resolution.* *Ramillies.* *Royal Oak.* *Royal Sovereign.*
2d Battle Squadron	*Barham* (flagship). *Valiant.* *Malaya* *Warspite.*
Battle Cruiser Squadron	*Hood* (flagship). *Repulse.* *Renown* (on detached duty). *Tiger.*
1st Light Cruiser Squadron	*Delhi* (flagship), *Dunedin, Danae, Dauntless, Dragon.*
2d Light Cruiser Squadron	*Caledon* (flagship), *Carysfort, Cleopatra, Cordelia, Coventry.*
Destroyers	*Castor* (light cruiser), 2 depot ships and 4 flotillas, consisting each of 2 flotilla leaders, and 16 destroyers.
Submarines	*Inconstant* (light cruiser), 3 flotillas of 7 boats each, with necessary depot ships and tenders.
Aircraft Carrier	*Argus.*
Battleship for Fleet Gunnery Service	*Agamemnon.*
Minelayer	*Princess Margaret.*
Trawlers, Drifters, and Tugs	As necessary for Fleet work.

MEDITERRANEAN

4th Battle Squadron	*Iron Duke* (flagship). *Emperor of India* *Marlborough.* *Benlow.* *Centurion.* *Ajax.*
3d Light Cruiser Squadron	*Cardiff* (flagship), *Ceres, Caradoc, Calypso. Concord, Centaur.*
Destroyers	1 flotilla, consisting of 2 flotilla leaders, 16 destroyers, and 1 depot ship.
Aircraft Carrier	*Pegasus.*
Special Service Vessel	1.
Danube Force	3 river gunboats and 6 motor launches.
Red Sea	2 sloops.

CHINA

Flagship	*Hawkins* (light cruiser).
5th Light Cruiser Squadron	*Cairo, Carlisle, Curlew, Colombo.*
Submarines	1 flotilla of 12 boats and 2 depot ships.
Sloops	4.
Gunboats for river work	14.
Aircraft Carrier	*Ark Royal.*
Special Service Vessel	1.

AFRICA

6th Light Cruiser Squadron	*Birmingham* (flagship), *Dublin, Lowestoft.*
Sloops	2.
Gunboats for river work	2.

SOUTH AMERICA

7th Light Cruiser Squadron	*Southampton* (flagship), *Yarmouth, Dartmouth, Weymouth,*
Sloop	1.

EAST INDIES

4th Light Cruiser Squadron	*Highflyer* (flagship), *Caroline, Comus.*
Sloops	3.
Special Service Vessel for Persian Gulf	1.
River gunboats for Tigris and Euphrates	2.

NORTH AMERICAN AND WEST INDIES

Flagship	*Raleigh* (light cruiser).
8th Light Cruiser Squadron	*Calcutta, Calliope, Constance, Cambrian.*
Sloops	2.

NEW ZEALAND

Sloops for South Sea Islands.

LOCAL DEFENCE FLOTILLAS

Portsmouth ....4 destroyers.
Chatham ....4 destroyers.
Devonport ....4 destroyers.
Firth of Forth ....4 destroyers.
Coast of Ireland ....1 sloop and 6 destroyers.
Gibraltar ....4 destroyers.
Malta ....4 destroyers.

SURVEYING SHIPS

Home Service ....6.
Foreign Service ....4.

PATROL, MINESWEEPING, TRAINING, AND FISHERY PROTECTION SQUADRON

3 sloops, 7 twin-screw minesweepers, and 10 trawlers have been detailed for this service.

TRAINING AND EXPERIMENTAL ESTABLISHMENTS

GUNNERY SCHOOLS

Portsmouth ....1 cruiser, 1 light cruiser, 1 destroyer.
2 trawlers, 1 motor launch, 1 tug.
1 diving tender, 1 monitor.
Chatham ....1 battleship, 1 monitor, 1 destroyer.
1 trawler, 1 motor launch, 1 diving tender.
Devonport ....1 cruiser, 1 monitor, 1 destroyer.
1 trawler, 1 motor launch, 1 diving tender.

TORPEDO SCHOOLS

Portsmouth ....1 light cruiser, 4 destroyers, 4 "P" boats.
4 trawlers, 2 drifters, 2 motor launches.
Chatham ....2 destroyers, 1 trawler.
Devonport ....2 destroyers, 1 trawler.

SIGNAL AND W/T EXPERIMENTAL ESTABLISHMENT

1 cruiser, 1 destroyer, 1 "P" boat, 1 whaler.

SEAGOING GUNNERY SHIP FOR QUALIFYING GUNLAYERS

1 battleship, 1 tug, 1 motor launch, 1 drifter.

NAVIGATION SCHOOL, PORTSMOUTH

3 twin-screw minesweepers.

CADET TRAINING

Seagoing Training Ships .....1 battleship, 1 cruiser.
Dartmouth College ....1 destroyer, 1 patrol gunboat, 1 motor launch.
Osborne College ....1 torpedo boat.

ANTI-SUBMARINE TRAINING

Portland ....1 depot ship, 4 "P" boats, 1 whaler, 1 drifter.
Shandon ....3 trawlers, 2 motor launches.

SUBMARINE TRAINING

Periscope School (Portland)	1 depot ship, 1 sloop, 1 launch, 4 submarines.
Submarine School (Portsmouth)	2 depot ships, 1 sloop, 1 motor launch, 2 launches, 6 submarines.

RESERVE FLEET

Rosyth	3 battleships, 7 "P" boats, 8 submarines.
	4 battleships, 3 battle cruisers.
Chatham	1 aircraft-carrier, 5 submarines.
	4 light cruisers, 1 flotilla leader.
Devonport	18 destroyers, 2 depot ships, 1 repair ship.
Portland	1 battleship, 3 light cruisers, 2 flotilla leaders, 16 destroyers, 1 depot ship. 1 monitor.
Portsmouth	2 battleships, 3 light cruisers, 2 flotilla leaders, 15 destroyers, 1 depot ship.
	6 submarines (attached to *Dolphin*).
	32 submarines (laid up).
Central Reserve of Twin-screw Minesweepers	42 (including 3 employed with training establishments).

APPENDIX II

ORGANIZATION TO SECURE FOR THE NAVY THE FULL ADVANTAGE OF SCIENTIFIC RESEARCH AND ADVICE.—To ensure that the full benefits of science shall be secured to the naval service, a department of scientific research and experiment has been constituted under the Third Sea Lord and Controller.

2. This department is under the charge of a specially selected scientist—with the title of director of scientific research—who will be responsible to the Controller for the general direction and organization of research work for naval purposes, and will work in close association with the naval staff.

3. It will be the duty of the department under the director of scientific research—

(a) To keep under constant review the progress in scientific knowledge at the universities and in all government and civil departments, institutions and establishments, in this and other countries, where research work is being carried out;

(b) To investigate all new scientific principles and developments thus brought to light, with the object of ascertaining whether they are likely to prove of value to the naval service; and

(c) To act as the normal channel through which outside scientific institutions and workers may be approached with a view to their undertaking research work for naval purposes.

4. The department will also maintain close association with the scientific work being undertaken in the various naval experimental schools, and it will be the duty of the director of scientific research from time to time to visit these schools, both to ensure that development of new or improved methods does not proceed without full consideration of the latest scientific discoveries that may bear upon the problems in hand, and to satisfy himself that scientific methods are being utilized to the most profitable extent.

5. Whilst it is only by the fullest exercise of the policy of "farming out" of problems that overlapping of work will be obviated and expense saved, especially in matters involving chemical research, there will always remain certain problems of especial importance to the navy and maritime world generally, for the solution of which no appropriate outside agency will be readily available. Thus, it is essential that the Admiralty should

possess some suitable establishment of its own. The complete equipment of the necessary laboratory near London would, however, entail considerable expense, and would, moreover, be wasteful in that the valuable installations would, in general, not be used to their full capacity. It has therefore been decided to provide what, in the circumstances, is considered to be the best and most economical method of meeting naval requirements, namely—to establish a naval research institute of moderate dimensions adjoining the National Physical Laboratory at Teddington. While this institute will be entirely controlled by the Admiralty, its close association with the National Physical Laboratory will offer exceptional facilities for research, and the scientific staff will gain the additional advantage of personal acquaintance with the work being carried out in that laboratory. Doubtless also arrangements can be made for the existing power, lighting, etc., plants at the National Physical Laboratory to be made available for the use of this naval adjunct.

6. The organization now proposed is also necessary for the purposes of an arrangement whereby, when required, scientists will be lent to naval experimental establishments for particular work, such as—

(a) Fundamental research work requiring sea environment.

(b) Assisting in the early stages of adapting some new scientific discovery to practical service use.

7. Further, a naval research institute is essential if the scientific work of the department is to remain of the highest order obtainable. It is a common experience among scientific workers that the ideas which mark real progress come during actual work with their own hands, and for this reason, in addition to those already set forth above, a laboratory is necessary wherein the scientific staff may work, and where the director of scientific research may personally investigate such problems as he, by training and experience, is specially fitted to undertake.

8. At present there exists a laboratory at Shandon. This establishment was set up during the war with the primary object of investigating methods of counteracting the enemy's submarine menace. The site was originally chosen on account of its proximity to deep water and of other facilities, but recent developments have shown that the limited and land-locked waters of the Gare Lock, and the distance from the open sea, render Shandon not well suited to the requirements of naval researches.

Apart, however, from its local imperfections, a great objection to the permanent retention of Shandon as the naval research institute lies in its great distance from the experimental schools, the various scientific institutions and the Admiralty, which latter must remain the center of control of scientific work for the navy.

9. It has accordingly been decided that so soon as suitable accommodation can be provided elsewhere Shandon is to be abandoned, such work as requires sea environment, together with the scientific personnel associated with it, being removed to a suitable existing naval school, and the remainder, which does not in its early stages require such surroundings, being transferred eventually to the naval research institute.

10. It will be admitted by scientists that their enthusiasm may render them liable to pursue some particularly promising line of research that is revealed in the course of their investigations, and although no doubt of value in the general interests of science, the results may have no particular bearing on the solution of problems likely to be of benefit to the navy. On occasions it may be wise to "give the scientist his head"; if, as is essential, we are to possess an organization which will command respect throughout the scientific world; but in order to guard against such tendencies being carried further than is considered justifiable, and to determine what particular line of research should be pursued in the best interests of the service, or the order of precedence in which particular problems should be attacked, the Controller is empowered to call to his assistance such outside scientists as he may consider desirable to form an advisory council

on which, as a matter of routine, the director of scientific research and representatives of other departments concerned will be invited to sit.

With this object in view, the Royal Society have already been approached and have consented to nominate two suitable fellows who will be willing to attend meetings. Admiral of the Fleet Sir Henry Jackson has also consented to give the council the benefit of his advice.

11. While the above sets forth the organization of scientific research for purely naval uses, it will be the constant endeavor of the Admiralty to work in close collaboration with the army and the air force for the joint prosecution of such researches as can profitable be undertaken in this manner. It may, in this connection, be desirable to state that there already exists the ordnance committee for dealing with ordnance questions affecting the navy and army; the W/T Board affords the necessary liaison between the three services in the matter of wireless telegraphy, and proposals are now under consideration for the creation of a joint (navy, army, and air force) establishment for the investigation of problems relating to chemical warfare.

FUTURE OF BRITISH SHIPBUILDING.—Whether British shipyards will in time be again turning out more tonnage than those of all the rest of the world put together affords an interesting subject for speculation. The latest one to write on this topic is Sir Herbert B. Rowell who, in an article appearing in the London *Spectator,* says that the future of British shipbuilding is inseparably bound up with that of the other countries of the world, and to gauge it requires a study not only of that larger subject, but of the capabilities of his country to recover and improve its position in the field of ship-owning. He says in part:

"Before the war we were paramount as the world's carriers, although menaced by the expansion of Germany. Other countries were also making themselves felt, but to an extent that attracted attention rather than anxiety. With the conditions now existing we must feel that, although the direction from which competition comes has changed, it is none the less real, and that it will take all our skill, experience, and industry to achieve our desired end. That this will be done, and that we shall see the flag of our country holding the place on the oceans of the world that it held formerly, is our hope and belief.

Present Situation Gauged.—"To-day we find ourselves in a position which requires careful weighing and gauging to enable us to arrive at a balanced conclusion, and this applies still more to our position in the future. We may take it for granted that our shipyards have more merchant tonnage under construction than at any previous period; that a considerable demand exists for further deliveries; that building on the whole, notwithstanding the recent falling off in America, is proceeding in foreign countries to an unprecedented extent; and that, on the other hand, we have reason to believe that there is now more tonnage afloat than ever before in the history of the world; also that it will for some time continue to be launched at a greater rate than ever before.

"Against these factors we must take into account that the government controls a considerable amount of tonnage which is being used ineffectively or not at all, and that the tonnage in the hands of shipowners for one cause or another, such as slow working of cargo or bunkers, strikes, want of terminal facilities, and other conditions, is also giving a ton mileage considerably inferior to its pre-war performance. The former of these conditions is certain to change before long, and the latter sooner or later; both, however, are sources from which a virtual increase in effective tonnage will come to supplement new construction, and a study of the future of shipbuilding requires that the potentialities of these two circumstances should be kept vividly before us.

"Against us we have great forces, although of varying character. In China we have efficient and inexpensive labor directed by highly trained

European supervision, with ample deposits of ore which are already being developed, and which promise in the near future to enable steel and other materials to be supplied at reasonable prices. There the works are extending and increasing; the supply of labor is inexhaustible, and regularity and diligence are its outstanding characteristics. In Japan the conditions are similar to those in China, except that the shipyard plants are larger, better equipped, and more modern. The management, which is highly efficient, is in the hands of Japanese who have been trained in the best works and colleges in Britain and America, with the thoroughness which characterizes this race. The greatest disadvantage that Japan labors under is that she is dependent on outside supplies for her steel; but this is being rectified by the acquisition of mineral areas in China and the development of the steel industry, which has already reached a producing stage in Korea.

America's Attitude.—"In America there is a determination and patriotic endeavor to establish herself as a shipowning and shipbuilding country of which we have not seen the end, and the realization of which is assisted by cheap material and efficient if expensive labor. The costs are high, but it is within the power of Americans to say: 'We *will* have, and *can* pay.' The reduction in the United States shipbuilding programme will, in spite of the present labor troubles, have a steady effect on the industry later as the demand for its services diminishes, and even though the result of the present dislocation be an increase in rates of wages, it is improbable that this will be permanent.

"In any case a comparison of the present earnings in America and this country does not give the ratio of their respective costs, as the extent to which mechanical appliances are used there, notably pneumatic tools, gives them a great advantage in volume and cost of work, which is further accentuated by the extraordinary adaptability and effectiveness of their labor. The quality of the ships turned out, especially in the newer yards, has been severely criticised from the view both of workmanship and design. In both respects I consider they are inferior to what is produced in this country, but too much importance has been attached to these features as a permanent handicap to the industry. The designing will improve as soon as it passes into the hands of the private builders and the quality of the work will improve under the fostering influence of Lloyd's surveyors, as it has done in other countries.

"In Germany industry is recovering, and she is working today at prices with which for several reasons—her depreciated currency not being the least—we cannot compete. In some other countries the better labor conditions go far to counterbalance the cost of material and fuel.

"In spite of all, however, I believe that, after the disciplinary period of competition through which the shipbuilding industry of the world is sure to pass, Britain will resume her place amongst the other nations as an economical producer."—*The Nautical Gazette,* June 5, 1920.

JAPAN

JAPANESE SHIPS TO BE PLACED IN RESERVE.—The *Fuso, Haruna,* and *Kirishima,* are nearing the "second age" period, and will soon be replaced by new ships.

The present division of ships of the Japanese Navy into ship's age is as follows:

	First period	Second period	Third period
Battleships	6	5	4
Battle cruisers	4	3	
Cruisers	7	4	14
Coast defense ships	1	..	5
Gunboats	..	16	2
Destroyers	45	35	..
Totals	63	63	25

JAPANESE SHIPOWNERS' PROTECTIVE LEAGUE.—According to advices received from the Orient, the Nippon Yusen Kaisha, the Osaka Shosen Kaisha, the Toyo Kisen Kaisha and a number of other large Japanese steamship companies have decided to join the Japan Ship Owners' Association. A powerful league of Japanese shipowners is expected to result from this action, which has been taken with the object of offsetting the inroads made into the Japanese carrying trade by the American and British shipping interests since the war. One of the objects aimed at is a closer co-operation between the Japanese shipping companies so as to eliminate competition between themselves and thus making it possible to meet effectively the competition of foreign shipping.—*The Nautical Gazette*, July 3, 1920.

JAPANESE EXHIBITION SHIP STARTING WORLD TOUR.—Japan has completed arrangements for a floating commercial museum. This is being established aboard one of the larger Japanese liners, which will sail from Yokohama on or about July 15. This education tour will take it into the principal ports of the world.

Stops will be made of from two to seven days, so that prospective buyers may see exhibits of Japanese inventions, fine arts, porcelains, lacquer-ware, raw and finished silk and other Japanese products.—*The Nautical Gazette*, July 3, 1920.

SHIPBUILDING IN JAPAN.—The new Japanese battleship *Mutsu*, which was laid down in 1918 at the Yokosuka Imperial dockyard, was successfully launched on the 31st of last month. This vessel is described as the largest in the Japanese Navy, from which it would appear that her sister ship, the *Nagato*, being built in dry dock at the Kure dockyard since August, 1917, has not yet been floated out. The type they represent is undoubtedly a most formidable one, and to those who are out of touch with current naval progress it may come as a surprise to learn that the *Mutsu* and *Nagato* are more powerfully armed than any ship in the British Navy, and larger than any warship now afloat, with the sole exception of H. M. S. *Hood*. Their chief dimensions are: Length, 661 feet; beam, 95 feet; draft, 30 feet; displacement, 33,800 tons. Geared turbines are to be installed in both ships, from which a speed of 23½ knots is anticipated. The main armament will consist of eight 16-inch guns. The Japanese ships, therefore, are slightly larger and considerably faster than their American contemporaries of the *Maryland* class, the name-ship of which was launched on March 20; but the main armament is the same in calibre and number of guns. Besides the *Nagato* and *Mutsu*, six further capital ships are under construction or about to be laid down in Japan, a number that will bring the establishment up to 17 dreadnoughts or, in popular parlance, "super-dreadnoughts," for all save one of the 17 are armed with guns exceeding 12 inches in caliber.

The exact position of the Japanese naval programme at the present moment is somewhat obscure. According to a government measure introduced late in 1917, a sum of £30,054,800, spread over a period of six years, was to be spent on the construction of two battle-cruisers, three light cruisers, 27 destroyers, and 48 submarines. Of this amount, £2,544,000 were to be disbursed in 1918, £4,771,766 in 1919, £5,412,381 in the current year, £6,819,635 in 1921, £7,122,673 in 1922, and the balance in 1923. Apparently, however, the programme was subsequently modified to include a larger proportion of capital ships. The ultimate aim of the Japanese Government, as explained at the time, is to realize the so-called "eight-eight" system, that is to say, squadrons each consisting of eight battleships and eight battle-cruisers, and to create in time at least three squadrons of this composition. But, irrespective of financial considerations, there are factors which augur none too well for the attainment of this goal within the measurable future. Since the close of the war shipbuilding in Japan has been seriously hampered by the difficulty of obtaining steel. She is dependent primarily on the United States and Great

Britain for her supplies of this material, and within the past two years her imports from both countries have fallen off considerably, owing, on the one hand, to transport difficulties in the States, and, on the other, to the fact that the unfavorable exchange situation makes it more profitable for British manufacturers to dispose of their steel in the European markets. So serious has the shortage become that this year's output of tonnage in Japan is expected to be less than 600,000 tons instead of the 800,000 tons forecast in January. This scarcity of steel is probably reacting on the naval programme, and may account in part for the delay in floating out the *Nagato*. When the war boom in shipbuilding was at its crest new yards sprang up in Japan with mushroom-like rapidity. Just before the armistice no less than 70 shipyards were at work in the Osaka district alone, a number that has lately fallen to 20. The home steel supply was gravely prejudiced at the beginning of the year by an act of sabotage perpetrated at the Yawata works, the only concern in Japan which is capable of producing large quantities of steel. So extensive was the damage that the works had to be closed down for several months. Another factor tending to retard the output of tonnage, naval as well as mercantile, is the higher rate of wages demanded by the shipyard workers. Four years ago the average daily wage of a Japanese shipwright was about a yen (2s.). The present-day average is doubtful, but it is certainly much higher, and fresh claims have lately been put forward on behalf of the workers. Thus the immense advantage which cheap labor gave to Japanese shipbuilders over their rivals in the Occident is gradually disappearing.

So far as technical efficiency is concerned, Japan unquestionably stands in the front rank as a shipbuilding nation. During the period of intensive construction brought about by the depredations of German submarines, many new "records" for quick building were made in the United States, and a yard at Ecorse, Detroit River, claimed to have "licked creation" by delivering the steamship *Crawl Keys,* of 2300 tons gross, 29 days after the keel had been laid. This achievement, creditable as it was, has, however, been surpassed by the Kawasaki dockyard at Kobe in the case of the steamer *Raifuku Maru,* of 5800 tons gross. The keel of that vessel was laid on October 7th, 1918, she was launched on October 30, and her official trials were successfully completed on November 5. In her case, therefore, the building period also covered 29 days, but she was larger than the American vessel by 3500 tons, a difference that makes the record much more noteworthy. In speed of naval construction the Japanese yards are equally well to the fore. The 31,300-ton battleship *Ise,* built by the Kawasaki Company, was completed in 31 months. Twelve 700-ton torpedo-boat destroyers, ordered in Japan by the French Government at the beginning of 1917, were all in service by the following August, some of them having been built so quickly that the average period for the twelve worked out at five months. In the light of these performances the assertion of a leading Japanese yard that, provided the necessary material was forthcoming, they would be prepared to deliver a battleship of the largest dimensions within 20 months from the laying of the keel, a light cruiser within 11 months, and a large destroyer within five months, does not appear to be exaggerated.

The rise and development of modern shipbuilding in Japan furnishes one of the most striking instances of the national adaptability. The squadrons which carried the Japanese flag to victory at the Yalu in 1894 and at Tsushima in 1905 had been constructed almost entirely in foreign shipyards. It was not until 1905 that the first large armored warship was laid down in a Japanese yard. But since that date more than a score of fine battleship and cruisers have been built and completely equipped by the national industry, and at the present moment, as we have seen, battleships of unprecedented size and power are approaching completion in Japan. The growth of the late Imperial German Navy during the 20 years preceding the war was regarded as phenomenal; but considering the great

difference in wealth and productive facilities of Germany and Japan respectively, the latter's achievement in the same sphere of endeavor is even more astonishing.—*The Engineer,* June 18, 1920.

UNITED STATES

MATÉRIEL

OUR NAVAL STANDING.—The fact that we are the only nation which has continued since the war to enlarge its battleship strength made it inevitable that the question of supremacy of the sea would arise and form the subject of discussion—in other words, that our naval policy should stimulate instead of helping to repress that race in naval armaments to which it was hoped that the extinction of the German Navy had put an end. Evidence of this thought and talk is found in an article by Archibald Hurd in a recent issue of the *Illustrated London News,* in which a very striking comparison is made of the strength in capital ships of our own navy and that of the British, when our present programme of construction shall have been completed, that is to say, about the year 1924.

Except for the finishing up of a few of the smaller types of vessels, Great Britain has no construction on hand and has no thought of laying down a new programme. The same is true of France and Italy. In this country, at the time the article was written, we had 18 capital ships authorized or under construction, each of which will be larger and more heavily armed than any existing ships in the world. The battleships include the *California* and *Tennessee,* of 32,300 tons, mounting eight 16-inch and 14 5-inch guns; the four battleships of the *West Virginia* type of 32,600 tons, mounting eight 16-inch and 14 5-inch guns; and, lastly, the six battleships of the *Indiana* class, each of 42,300 tons displacement, mounting 12 16-inch and 16 6-inch guns.

In addition to these are the six battle-cruisers of the *Lexington* class. The designs for these huge ships have been greatly modified, the speed having been reduced, but the size increased. The displacement has risen to 43,500 tons, and they are thus the largest capital ships of any kind on paper or afloat. They will carry eight 16-inch and 14 5-inch guns.

For the purpose of comparison, Archibald Hurd considers that both battleships and battle-cruisers should be divided into two classes, since the first class, or super-dreadnought, to use a rather common but ambiguous term, are so much more powerful than the earlier dreadnoughts or battleships as to require a separate designation. He considers the same thing to be true of the battle-cruisers. So, basing his comparison on the determination of the British to lay down no new ships for a while, he estimates the relative naval strength of the two leading naval powers will stand in 1924 as follows: In first-class battleships, the British have ten carrying the 15-inch gun, and we shall have ten mounting the 16-inch gun; in second-class battleships, the British have 13 mounting the 13.5-inch gun, and our navy will have 11, mounting the 14-inch gun.

In first-class battle-cruisers, the British have three mounting the 15-inch gun, and we shall have six mounting the 16-inch gun. Of second-class battle-cruisers, armed with the 13.5-inch gun, the British have three; we shall have no second-class battle-cruisers. Summing up, we find that by 1924 the British will have 13 first-class capital ships against 16 in the American navy, and that they will have 16 second-class capital ships as against 11 in the United States Navy. As a final consideration, he asks whether, in view of the modifications which are sure to be made, as the records of the war are studied, it would not be better to delay the construction of new ships for two or three years as the British are now doing. The answer to that is that our new battleships and battle-cruisers are supposed to embody the facts of more experience.—*The Scientific American,* June 26, 1920.

"MARYLAND"—OUR FIRST 16-INCH-GUN BATTLESHIP.—The super-dreadnought *Maryland* now completing at Newport News, Va., is the fourth electrically propelled battleship of the United States Navy and sister ship of

NAVY DEPARTMENT—BUREAU OF CONSTRUCTION AND REPAIR

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—DEGREE OF COMPLETION, AS REPORTED JUNE 30, 1920

Type, number and name	Contractor	Per cent of completion			
		July 1, 1920		June 1, 1920	
		Total	On ship	Total	On ship
Battleships					
44 California	Mare Island Navy Yard	92.4	90.1	92.4	89.1
45 Colorado	New York S. B. Cpn.	51.1	40.8	49.1	38.3
46 Maryland	Newport News S. B. & D. D. Co.	76.	74.	74.	71.
47 Washington	New York S. B. Cpn.	47.8	35.8	45.6	33.3
48 West Virginia	Newport News S. B. & D. D. Co.	30.5	13.5	29.	11.
49 South Dakota	New York Navy Yard	12.5	5.	11.6	4.1
50 Indiana	New York Navy Yard	10.1	2.6	10.0	2.5
51 Montana	Mare Island Navy Yard	10.9	2.9	9.8	2.2
52 North Carolina	Norfolk Navy Yard	12.5	6.5	10.8	5.4
53 Iowa	Newport News S. B. & D. D. Co.	4.5	2.	3.9	1.
54 Massachusetts	Beth. S. B. Cpn. (Fore River)	....	......	....	....
Battle Cruisers					
1 Lexington	Beth. S. B. Cpn. (Fore River)	.6	......	.5	....
2 Constellation	Newport News S. B. & D. D. Co.	.6	......	.5	....
3 Saratoga	New York S. B. Cpn.	.7	.2	.6	.2
4 Ranger	Newport News S. B. & D. D. Co.	.6	......	.5	....
5 Constitution	Phila. Navy Yard	1.	.3	.8	.1
6 United States	Phila. Navy Yard	1.	.3	.8	.1
Scout Cruisers					
4	Todd D. D. & Const. Cpn.	54.7	40.5	50.9	35.5
5	Todd D. D. & Const. Cpn.	49.9	30.5	44.9	24.3
6	Todd D. D. & Const. Cpn.	29.7	6.4	29.5	4.3
7	Beth. S. B. Cpn. (Fore River)	6.	2.9	5.5	2.6
8	Beth. S. B. Cpn. (Fore River)	6.	2.9	5.5	2.6
9	Wm. Cramp & Sons Co.	45.	......	41.	....
10	Wm. Cramp & Sons Co.	43.	......	37.	....
11	Wm. Cramp & Sons Co.	19.	......	18.	....
12	Wm. Cramp & Sons Co.	19.	......	18.	....
13	Wm. Cramp & Sons Co.	19.	......	18.	....
Miscellaneous					
Fuel Ship No. 17, Neches	Boston Navy Yard	84.	83.	77.	75.8
Fuel Ship No. 18, Pecos	Boston Navy Yard	31.5	20.	29.	16.9
*Gunboat No. 21, Asheville	Charleston Navy Yard	99.8	99.8	99.5	99.5
Gunboat No. 22	Charleston Navy Yard	48.2	36.2	39.	29.
Hospital Ship No. 1, Relief	Phila. Navy Yard	89.5	87.5	85.	81.5
Amm. Ship No. 1, Pyro	Puget Sound Navy Yard	99.9	99.9	99.6	99.
Amm. Ship No. 2, Nitro	Puget Sound Navy Yard	98.	94.	97.	92.
Rep. Ship No. 1, Medusa	Puget Sound Navy Yard	50.8	38.	46.	35.
Destroyer Tender No. 3, Dobbin	Phila. Navy Yard	24.7	23.	21.7	19.
Dest. Tender No. 4, Whitney	Boston Navy Yard	......	......	....	....
Sub. Tender No. 3, Holland	Puget Sound Navy Yard	4.2	......	2.5	....
Oil Tankers					
1653 Mattole	Wm. Cramp & Sons Co.	98.	......	96.	......
1660 Tippecanoe	Newport News S. B. & D. D. Co.	95.	......	85.	......
1661 Trinity	Newport News S. B. & D. D. Co.	85.	......	75.	......

* Commissioned July 6, 1920.

There are, in addition to the above, 70 destroyers, 51 submarines, and five sea-going tugs in various stages of construction.

There were completed and delivered to the Navy Department during June nine destroyers and one submarine.

There are 12 destroyers, seven submarines and one transport authorized but not under construction or contract.

the *California,* which is being put into commission at the Mare Island Navy Yard, San Francisco. She is also the first United States ship to mount the new 16-inch gun of which she carries eight in four turrets.

Like her prototype, the *New Mexico,* pioneer electric warship of the world, the *Maryland* is electrical throughout.

Her propulsion equipment was designed and manufactured in the shops of the General Electric Company at Schenectady, N. Y., a city, which because of its pioneer work in electric propulsion has, in a sense, come to be known as the birthplace of electric drive.

Four huge electric motors 12 feet in diameter weighing 62 tons and producing 7000 horsepower each, revolve the great propellers. The current is

ONE OF THE PROPELLER MOTORS.

obtained from two turbo-generator units driven by steam from nine oil-heated boilers placed in three separate compartments of the ship. Approximately 28,000 horsepower is thus available for propulsion purposes or enough to supply power to a city of 100,000 population.

Steam from the boilers under pressure of 250 pounds to the square inch expands into a Curtis turbine and revolves the turbine blades at high speed. This turbine is directly connected to a generator which produces electric current. Through copper cables this current is then led to a control board where it is measured and passed on to the motors which drive the propellers of the vessel.

A portion of the steam produced in the ship's boilers is diverted to six auxiliary turbo-generator sets which create additional energy for the operation of many other electric features of interest.

These auxiliary generating units for instance will supply the vessel's lighting, operate fans and blowers, run the electric bakery, drive the machine tools used in the foundry, carpenter shop and machine shop, operate the electric laundry equipment, assist in loading the big guns, raise and lower the life boats by means of boat cranes and hoist and lower the ship's great anchors.

Electricity will also be used in the refrigerating room which by means of motor-driven pumps, will produce many pounds of ice a day. Electrically-operated pumps will distill gallons of fresh water from the salt waves for the use of the crew and to furnish the boilers with fresh water.

Among other auxiliary uses of electricity on the *Maryland* may be mentioned searchlights, ammunition hoists, electric cooking utensils, telephones and intercommunication systems, gyroscopic compasses, steering gear apparatus (the ship will be steered electrically), motors for revolving gun turrets, air compressors and many other devices making the *Maryland* an electric ship indeed.

The *Maryland* is 624 feet long, weighs 32,600 tons and has a total fuel capacity of about 1,000,000 gallons of oil.

We give below, in chronological order, the various steps in the evolution of the electric drive in the United States:

1907.—First application of the principle adapted to fire-boats in the city of Chicago.

1912.—*U. S. S. Collier Jupiter*, first naval vessel of any nation equipped for electric drive launched at Mare Island Navy Yard, San Francisco, after design of Dr. W. L. Emmet of General Electric Company.

1917 (April).—Emmet's principles applied to *U. S. S. New Mexico*, built and launched at New York Navy Yard.

1919.—*U. S. S. Tennessee*, launched at New York Navy Yard. Navy Department adopts electric drive for six new battle-cruisers to have a speed of 33¼ knots and develop 180,000 horsepower each.

1919 (October).—Fishing trawler of 100 tons equipped with electric drive, the first installation of its kind to vessels of this class.

1919 (November).—Launching of *U. S. S. California* at Mare Island.

1920 (March).—*U. S. S. Maryland*, launched at Newport News, Va.—*The Scientific American*, June 26, 1920.

TWO YEARS OF ELECTRIC PROPULSION ON THE "NEW MEXICO."—As the *New Mexico*, the first United States battleship to be fitted with electric drive, was placed in commission at the New York Navy Yard in May, 1918, she is now just completing her second year of active service. During that time she has seen service of practically every kind that is encountered by a battleship except actual engagement in battle. The results of this service, according to Commander S. M. Robinson, U. S. N., fleet engineer of the Pacific fleet, of which the *New Mexico* is the flagship, have been highly satisfactory and justify the judgment of those who are responsible for the installation of electric machinery in the vessel.

As Commander Robinson gave a very complete description of the *New Mexico's* machinery in this magazine a year ago, it will be remembered that the electric machinery for propulsion consists of two main turbo generators rated at 11,500 kilowatts each at 80 per cent power factor and having an overload capacity of 25 per cent, four main motors rated at 7250 horsepower each and having an overload capacity of 25 per cent, two boosters for varying the current of the main field, two 300-kilowatt exciters for supplying the current to the main field and also certain electrically-driven auxiliaries, together with a main switchboard, an exciter switchboard and the necessary wire and cable. The ship uses one generator for speeds up to 17 knots and two generators for speeds from 17 knots to full speed, which is between 21 and 22 knots. For speeds up to 15 knots the motors are run on the 36-pole connection, so that at 15 knots the turbine

is running at its designed full speed; from 15 knots to full speed the motors are run on the 24-pole connection. This arrangement gives good economy at all speeds, and in order to give our readers a definite idea of just what results have been obtained, Commander Robinson has prepared the following report:

The *New Mexico* has been operating for nearly a year in company with two sister ships, the *Idaho* and *Mississippi*, which have hulls identical with that of the *New Mexico*. During this time it has been possible to get an accurate comparison of the relative economy of the three ships and also the relative maneuvering qualities. In the latter respect, the *New Mexico* is decidedly superior, and the remarkable part of it is that nearly all the maneuvering in restricted waters has been done with one turbo-generator. When this installation was first proposed, its opponents maintained that, while a ship like the *Jupiter* could be satisfactorily operated with the screws on both sides of the ship running at exactly the same speed, it would not be possible to get satisfactory operation with that arrangement on a ship which had to operate in formation. But exactly the reverse has proved to be true; it has been found that more satisfactory operation is obtained when using one generator than when using two, and it is customary, when in dangerous waters where it is desired to take all possible precautions, to use one generator for driving the ship and to keep the other turning over idle. If the ship is getting under way from an anchorage and has to turn, as soon as the anchor is away the signal is given for standard speed ahead on one side and the same speed astern on the other; with this arrangement the ship will turn absolutely on her heel without gaining ground either ahead or astern; with other engines, where it is not possible to regulate the speed so quickly and accurately, the probability of getting speed on the ship in one direction or the other is much greater. All the predictions in regard to trouble on account of the condition that when operating with one generator the screws on both sides of the ship must run at the same speed (if run at all) have proven to be groundless.

In regard to the comparison of economics the results have been very favorable to the *New Mexico*. The *Idaho* and *Mississippi* are fitted with direct-connected turbines (one is Parsons and the other Curtis) and have geared cruising turbines; the *Idaho* can use her cruising turbines at all speeds up to about 17 knots and the *Mississippi* can make about 15 knots with her cruising turbines. Experience gained by a comparison of detroyers fitted with geared main turbines and those fitted with direct-connected main turbines and geared cruising turbines indicates that the economy of the *Idaho* and *Mississippi* at cruising speeds is about as good as it would be if they had geared main turbines. A comparison of the *New Mexico* with these ships is therefore particularly interesting at the lower speeds.

The advocates of electric propulsion have always claimed that it was very superior to all other forms of propulsion at the cruising speeds, but even the most enthusiastic of these have been surprised by the remarkable showing made. This is doubtless due to the fact that no one made sufficient allowance for the saving due to shutting down one generator and all the auxiliaries that go with one of the condensing plants. At a speed of 10 knots the *New Mexico* uses about 16.7 per cent less oil than her sister ships, or, putting it another way, her sister ships use about 20 per cent more than the *New Mexico;* at 13 knots the figures are 29.9 per cent or 42.7 per cent; at 16 knots the figures are 32.3 per cent or 47.8 per cent; at 19 knots the figures are 28.6 per cent or 40.1 per cent; at full power the figures are 24.4 per cent or 32.2 per cent. At 19 knots and also at full power the *New Mexico* uses about .975 pound of oil per shaft horsepower per hour, and at 15 knots she only uses 1.1 pounds of oil per shaft horsepower per hour. This is a remarkably uniform economy.

The *New Mexico* has just completed her annual full-power trials and the following table gives an analysis of the data obtained:

	Full power	Endurance
Revolutions per minute	167.4	151.7
Speed (knots)	21	19.35
Shaft horsepower	28,820	21,650
Pounds of oil per shaft horsepower per hour	.975	.973
Pounds of oil per square foot of heating surface	.506	.3795
Estimated water evaporated in pounds per hour	395,500	294,700
Estimated water per shaft horsepower in pounds per hour (all purposes)	13.65	13.62
Pressure (gage) in pounds per square inch at the boilers	270	265
Pressure (gage) in pounds per square inch at the turbines	255	260
Superheat (in degrees Fahrenheit)	32	23
Vacuum	28.7	29.0

In regard to the reliability of the machinery, the *New Mexico* has had nothing but the most minor troubles with her electric plant and there have been no navy yard repairs whatever; there has been one serious accident to the steam part of the machinery which required work to be done by a navy yard, but that was due entirely to a mechanical defect. Due to improper construction of the main governor, one of the weights became detached while the turbo-generator was running without load; the turbine ran away and operated the emergency governor, which tripped the throttle, but the latter did not entirely close and the turbine ran at over-speed sufficiently to stretch the turbine wheels and the entire rotor had to be replaced. The governor has been changed and additional over-speed protection given by arranging for the emergency governor to close the admission valves as well as the main throttle. The machinery has been in operation nearly a year since repairs were completed and no further trouble has developed.

In conclusion, it may be said that the performance of the *New Mexico* since commissioning has been entirely satisfactory in every way and that the expectations of those who were responsible for its installation have been more than realized.—"International Marine Engineering."—*A. S. N. E.*, May, 1920.

PERSONNEL

THE DISCIPLINE OF THE NAVY.—The continued controversy and bitter feeling arising from the Senate investigation of the navy's conduct of the war has brought about a situation most unfortunate for the best interests of the navy, and one that is utterly subversive of navy discipline. The injection of politics into service affairs has always been, and it is to be feared will continue to be, a serious injury to its best interests. It is the opinion of many conservative officers of the navy that certain very able officers of the navy are being exploited for political purposes, perhaps without their being fully aware of that fact; and that politics and partisanship have no less been injected into navy affairs by certain of those in authority. Whatever may be the justice of the grievance of officers who feel that political or personal motives have been allowed to influence official action, however admirable may be their purpose in desiring to better the efficiency of the service, it is most unfortunate that this should lead to public attacks upon those in authority. Whatever may be the justice of official resentment against criticism, it is doubly unfortunate that this has found expression in appeals to prejudice, in counter attacks that may be regarded as ingenious examples of special pleading, rather than in proper judicial action and unbiased statements of fact. For the present state of undiscipline, to give it its mildest description, the lack of a judicial attitude on one side has led to appeals to the extra-judicial tribunal of public opinion on the other.

The result can only be injury to the service. Discipline and respect for authority are the foundation stones of the navy as well as of the army; a judicial and unbiased attitude on the part of those in authority is no less essential. Partisan or political appeal should have no part in service affairs. Our civic affairs are largely conducted by appeals to public opinion, as a court of last resort, and in a government such as ours wherein all may share this method of open discussion is without doubt an admirable one. But for the services the people as the court of last resort have already set forth in the laws made through their representatives the methods of orderly procedure, the established rule and regulation, that are best conducive to the needs of military discipline. An appeal beyond the law to the court of public opinion that established that law may be made with no other intent than a desire to correct conditions that are an injury to the service. Yet such appeal can but result ultimately in a worse injury to the service than the evils it is desired to correct—may lead to the disruption of discipline, the undermining of the spirit of loyalty to superiors in command. Without discipline, without respect for authority, military or naval organization is ineffective. Authority should deserve respect and should make itself respected; but whether or not it does so, those with the best interests of the navy at heart must recognize the injury to discipline and to the service of appeals against authority that go outside the channels of regulations and of navy law.—*The Army and Navy Journal*, July 3, 1920.

MERCHANT MARINE

JONES BILL SIGNED BY PRESIDENT.—After weeks and months of doubts and heart-searching the Jones Bill, reconstituting the Shipping Board, arranging for the disposition of the Board's tonnage, and vitally affecting the future of the American merchant marine, passed both houses of Congress on June 4, and was signed by the President the following day.

In many respects the Jones measure is a new shipping act, for it gives the Shipping Board powers over shipping not previously possessed. In all probability the Board will in the near future put into operation several policies which have been in abeyance pending passage of the bill. Among these are a new sales programme, a revised agency agreement with managers and operators, a ship repair policy and a general formulation of policy to conform with the sections of the new law.

Secretary of State Bainbridge Colby made a protest against the approval of the bill, based on an examination by the law officers of the State Department, who declared that in several sections the shipping bill violated existing treaties. It was also believed by them that the provisions as to the ex-German ships and their disposition by the Shipping Board would involve the Government in litigation and that the whole matter would be thrown into the courts.

It is recalled that the State Department objected at the time to the preferential tariff provision of the Underwood Bill on the ground that it violated existing treaties. On that occasion President Wilson declared that the portion of the act in question was unconstitutional and therefore of no effect.

Excess Profits Section.—The section dealing with the war profits and excess profits taxes had to be referred back to the conference committee, as the Speaker ruled the section out of order. As passed, the latter provides that owners of American vessels engaged in foreign trade shall for ten years be permitted to deduct from their income tax return the net earnings of their steamers, provided such net earnings are invested in new tonnage in American yards.

However, two-thirds of the cost of such new tonnage shall be paid out of the ordinary capital or funds of the shipowners. The section also provides that in the case of the sale of a vessel, income taxes shall not be payable provided the entire proceeds of the sale be invested in new tonnage in American shipyards.

Under the bill the sale of vessels to aliens can be ordered by the Board only after five of the seven members have agreed that they cannot be disposed of to advantage in the domestic market. The Senate provision limiting the sale to aliens of vessels not exceeding 6000 tons and not less than ten years' old, was stricken out.

The limitation placed on sales to foreigners is outlined in a section providing that "no such sale shall be made unless the Board, after diligent effort, has been unable to sell in accordance with the provisions directing the sale to American citizens and has, upon the affirmative vote of not less than five members, determined to make such sale, and it shall make as a part of its record a full statement of its reasons for making such sale."

Sale of Tonnage.—The sale, to American citizens, may be made on such terms and conditions as the Board may prescribe, with a limit of 15 years for the final payment and at an interest rate on the deferred payments to be fixed by the Board.

The bill provides that 75 per cent of the stock of vessels operating in the trade and the majority of the stock of vessels operating in the foreign trade shall be held by American citizens.

A revolving fund of $25,000,000 to be made up of proceeds of the sale and operation of ships by the Board as created, from which the Board may make loans to any company, corporation or individual, wishing to establish new ship routes, for the building of ships. The revolving fund will operate for five years.

The former German piers at Hoboken are to be turned over to the Shipping Board January 1, next, while other property acquired during the war, except the former German liners already in the hands of the Board, will be turned over at the discretion of the President.

The city of Hoboken is not recompensed for loss in taxation due to the Government acquiring the former German property in that city.

Marine insurance companies may combine, without coming under the jurisdiction of the Sherman or other anti-trust laws, for the "taking of marine insurance risks."

Similar provision is made for the combination of the resources of banking interests for the issuance of ship mortgages.

Coastwise Shipping.—The laws affecting coastwise shipping, which make a monopoly for American ships, may be extended to trade with the Philippines by directions of the President.

The bill provides that the Shipping Board shall be composed of members representing different sections of the country, as follows: Atlantic Coast, two members; Pacific Coast, two members; Gulf States, one member; Lake States, one member, and interior States, one member. The conference committee added the provision that not more than four of the seven members of the Board "may be of one political faith."

The annual salary of members of the Shipping Board is increased from $7500 to $12,000.

Japanese Objection.—From Tokio, Japan, a cable states that, according to the *Hochi Shimbun,* Japan will protest against the Jones Bill, especially in regard to its relation to the shipping of the Philippines. The protest, the Japanese newspaper says, will be made on the ground that the measure is a discriminatory violation of the Japanese-American commercial treaty and represents a blow to Japanese shipping.—*The Nautical Gazette,* June 12, 1920.

AMERICA'S NEW SHIP POLICY.—Has Uncle Sam forfeited the good will of England, France, Norway, Sweden, Holland, and Japan by enacting into law Senator Jones's Merchant Marine Bill? Some of our discerning editors, both on the Atlantic and Pacific seaboards and throughout the central West, shake their heads as they read certain drastic provisions of the Jones Shipping Bill which run counter to obligations assumed by the United States in no less than 24 commercial treaties. Since 1815, they

point out, this country has maintained reciprocal relations affecting shipping with foreign governments, and these agreements were made binding in the form of treaties. Many provisions of the Jones Act, they aver, are discriminatory in favor of American shipowners and against the fleets of other nations.

The New Republic (New York), however, declares that "the Merchant Marine Act is the one notable achievement of the late Congressional session," and the Rochester *Post-Express* agrees. The New York *World* asserts that it is in reality "the most important legislation of its kind ever enacted by Congress." "The big thing," editors agree, "is that a beginning has been made toward restoring the American flag to its proper eminence on the seas." "Only the skilful management, wisdom, and persistence of Senator Jones, of Washington, carried the bill through," agree *The New Republic* and the New York *Journal of Commerce,* and we read in the latter paper that—

"Senator Jones nursed the Shipping Bill through the Senate Committee hearings over a period of two months, framed its provisions in cooperation with the Shipping Board and other members of the committe, prest its passage by the Senate, worked over its sections in conference, and finally led the fight for the measure in Congress. As the man most largely responsible for the act, he speaks authoritatively in interpreting its intentions."

"This is an American act; it is intended solely for American interests," bluntly asserts Senator Jones. Furthermore he goes on:

"European Powers are freeing themselves from treaty provisions that will hinder them in the struggle for the world's trade. We have been prevented from doing what many thought should be done to aid our merchant marine by treaties entered into many years ago. This is a splendid time to unshackle ourselves and put ourselves in a position to make such treaties, to enter into such commercial relations, and to enact such laws as we think will promote our welfare in the world's readjustment. Other nations will look after their interests. We must look after ours.

"British Lloyd's is one of the greatest factors in maintaining a British merchant marine. We should have a similar organization in this country, and we feel that the American Bureau of Shipping should be to our shipping what Lloyd's is to British shipping. We therefore provide in this act for its encouragement by direction all governmental agencies to use that bureau for classification purposes.

"American mail should be carried in American ships, if at all practicable. Of the more than $3,000,000 paid every year for carrying our mail overseas about $2,500,000 is paid to foreign ships. This is so much aid or subsidy to them. This we want stopt. We want our mail carried in our ships."

The question of the right of the Government to dispose of the ex-German liners has been definitely settled by the Jones Act, we are told in *The Annalist* (New York), and there are provisions for the exemption from excess- or war-profits taxes of the net earnings of ships engaged in foreign trade for a period of ten years, with the understanding that the shipping companies must invest, either in government-owned ships or in new construction in American ship-building yards, a sum equivalent to the amount they otherwise would have had to pay in taxes. The act also forbids American railroads to grant export rates on freight to be carried in foreign ships, and it directs the President to repeal or abrogate all commercial treaties which prevent the United States from returning to the system of preferential duties. In order to meet foreign competition, the Government may not only charge lower duties, but it may grant lower port charges and canal tolls. All these concessions are not calculated to arouse great enthusiasm in foreign shipping circles, and there are intimations from abroad that retaliatory measures will soon be in order. Some of them are also criticized in our own country, by the New York *Journal of Commerce,* which says:

"Not the least dangerous element of protection is the grant of low export-rates to goods carried in American bottoms—a measure sure to invite retaliation. Highly objectionable also as a piece of special privilege is the section exempting shipowners from income and excess-profits taxes for ten years to come provided that they annually reinvest in ship construction a sum equal to the taxes they would otherwise have paid to the Government. The legislation is against the spirit of the times, opposed to all sound, economic doctrine, and essentially inequitable. It is more nearly modeled upon the lines of Prussian protectionism as exhibited in Germany before the war. It must, therefore, be a failure in the broadest sense of the term."

The Journal of Commerce of Liverpool is no less outspoken in its criticism of the new Merchant Marine Act. We read:

"It is realized that a United States mercantile marine can not be operated at the same costs as British, Norwegian, Dutch, or Japanese shipping, and it is therefore necessary to extend to shipowning interests in the States the large measure of protection which has always been favored for the development of United States home trade. Whether this policy of coddling will yield the desired results is at least doubtful. Our own shipowning industry has assumed the foremost place without any of the careful nursing which is to be accorded to United States merchant shipping, and the British mercantile marine asks for nothing more than a fair field against all rivals."

"But the common-sense view will be that the United States is solely within its rights in regulating what is, in effect, purely internal commerce," declares the Memphis *Commercial Appeal,* and the New York *Tribune* reminds us that "we built a merchant marine as a matter of military policy, and we expect to keep it both for military and economic reasons. The expansion of the merchant marine is a matter of national concern, to be promoted by all legitimate methods." The Newark *News* looks upon the Jones Act as "a new charter of rights for the American merchant marine," and, adds *The Sun and New York Herald,* "Great Britain can hardly be blamed for watching with something like alarm our 10,000,000-ton merchant fleet." As to our competitors in the shipping business abroad, and the methods which they are said to be contemplating using to maintain their prestige, this paper goes on:

"The hints from London regarding retaliation if we do adopt a preferential policy say that England employed no such discriminatory means to build up her merchant marine, which achieved brilliant and powerful success through a policy of 'no fear and no favor.' Any one who knows the slightest thing about the British merchant marine policy knows this is not a fact.

"England has a perfect right to take these measures if they are necessary to her welfare or if she so desires, her ships; insurance companies, docking facilities, foreign-port concessions, control of trade routs were all obtained by British brains, energy, money, or courage, and England has full freedom to use them as she will for the promotion of her commerce. But to deny to us or to anybody else the same right by saying she practises no shipping discrimination is a plea which must be laughed out of court."—*The Literary Digest,* July 3, 1920.

THE REGISTRATION OF AMERICAN SHIPPING.—It is quite easy to realize the anxiety of those interested in American shipping to make every effort in order to carry on that particular branch of industry apart from any association with the organizations of other nations. It would appear that the Shipping Board of the United States has issued instructions that the managers and operators of vessels belonging to the Shipping Board must obtain their classification from the American Bureau of Shipping. In order

to encourage the development of this practice we understand that the bureau is prepared to make examinations without charge and to issue the necessary certificates resulting from such examinations. The primary object, as far as we can see, is the carrying out of the intentions of the Government to supersede Lloyd's by discontinuing the Lloyd's classification of all American-owned ships. As far as one is able to judge there does not appear to be very much hope that this result is likely to be achieved at any near date in the future, even if it is ever achieved, for the reason that Lloyd's classification has world-wide significance and it will take a long time to break down the desire of shipping owners for Lloyd's classification, mainly for the reasons that underwriters are assured that it is so much better than that of any other organization and a strong feeling prevails that vessels classed under *Lloyd's Register* can always get a better sale. The probability is that political and national influences are dominating the action of the American Shipping Board, but if this is so, the fact must not be overlooked that such considerations do not appeal in any large measure to men of business dealing with problems from a commercial point of view. Although such a policy could be carried out when ships were under the control of the American Shipping Board assuming, however, that those ships passed into the hands of private people, the question of classification and survey will mainly be determined on commercial grounds. We do not see any cause to look upon this action of the American Shipping Board with any anxiety for the reason that all shipping owners of any nationality recognize that the classification of *Lloyd's Register* opens all the markets of the world to the owner desirous of disposing of a vessel from his fleet.—*The Marine Engineer and Naval Architect*, June, 1920.

DECK CREW'S NEW WAGE SCALE.—Below is the new monthly wage scale for American deck crews negotiated between the shipowners, the Shipping Board, and the Eastern and Gulf Sailors' Association. It is to remain in effect until May 1, 1921:

Carpenter	$100.00
Carpenter's mate	95.00
Boatswain	95.00
Boatswain's mate	90.00
Quartermaster	87.50
Able seaman	85.00
Ordinary seaman	65.00
Boy	40.00

—*The Nautical Gazette*, June 5, 1920.

A COMPARISON OF SHIPBUILDING.—The world's shipyards are building a greater volume of sea-going tonnage to-day in the shape of steel steamships than ever in their history, says a statement just issued by *Lloyd's Register of Shipping*, giving returns from all maritime countries. Steel steamers under construction for the quarter ended April 1 are reported to have aggregated 7,692,000 gross tons, as compared with 4,935,000 tons at September 30, 1918, and 7,504,000 tons at September 30, last, the latter being the high record until the quarter just ended.

Total tonnage of all kinds under construction shows a decrease however, the aggregate being 7,941,000 tons, as against 8,048,000 tons on September 30, 1919. This is accounted for by the progress of the Shipping Board's programme towards completion and the marked decline in the building of wooden steamers. Only 105,000 tons of this type of construction are under way, as contrasted with 1,324,000 tons just before the Armistice, since which time there has been a steady falling off. This has been most marked in the United States, where the shrinkage has been from 1,169,000 tons at September 30, 1918, to 55,000 tons to-day.

Figures for the first quarter of this year show that Great Britain now holds the lead in shipbuilding over the United States by a margin of 821,000 tons, although this country led by 1,930,000 tons a year ago. At the beginning of this year the two countries were neck and neck, the advantage being only slightly with the United Kingdom. The following table shows how the two countries have stood relatively at the ends of the various quarters in the total gross tons under construction:

	United States	United Kingdom
Sept. 30, 1918	3,382,000	1,746,000
Dec. 30, 1918	3,645,000	1,979,000
Mar. 31, 1919	4,185,000	2,254,000
June 30, 1919	3,874,000	2,524,000
Sept. 30, 1919	3,470,000	2,816,000
Dec. 31, 1919	2,966,000	2,994,000
Mar. 31, 1920	2,573,000	3,394,000

This includes all types of tonnage. In the construction of steel steamers the margin is a wider one. At September 30, last, the United States still led by 279,000 gross tons; but by the end of the year the United Kingdom had a lead of 334,000 tons and has now extended it to 961,000 tons.

But while Britain is building a greater number of steel steamers and a considerably greater aggregate tonnage than this country, the average size of her ships is considerably smaller, her 814 of 3,379,000 gross tons, averaging only 4,151 tons, as against 5,373 tons for the 450 American ships of 2,418,000 tons.

In the United States more tonnage of all kinds is being built in the shipyards of the Atlantic Coast than in those of the Gulf ports, the Great Lakes and the Pacific Coast combined. In steel steamers the difference is even more marked, nearly 60 per cent of this type of construction being under way along the eastern seaboard. The following table shows the distribution by districts in gross tons:

	All types	Steel steamers
Atlantic Coast	1,602,167	1,585,827
Gulf ports	213,193	180,793
Great Lakes	173,375	173,375
Pacific Coast	584,563	478,163
Total	2,573,298	2,418,158

A year ago the United States was building nearly 54 per cent of all the tonnage underway in the world, as compared to 29 per cent for the United Kingdom and 17 per cent for all other countries. Today this country is constructing 32 per cent, against about 43 per cent for Great Britain and about 25 per cent for all other countries. Excluding Great Britain, however, America is building 80,000 tons more than all the other countries combined.

Between them the United States and the United Kingdom are turning out three-fourths of the world's tonnage and no other country is within measurable distance of either of them. Japan, which has held third place from the time of the Armistice to the beginning of this year, has now been passed by both Holland and Italy and is being pressed by France. All three of the latter made gains during the past quarter, while Japan fell back from 309,000 tons to 285,000.

The distribution of shipbuilding at the beginning of April, as compared with the previous quarter, was as follows, in gross tons:

	Mar. 31, '20	Dec. 31, '19
United States	2,573,298	2,966,515
United Kingdom	3,394,425	2,994,249
Canada	169,623	188,375
Other Dominions	61,636	63,105
Belgium	25,640	26,293
Brazil	5,366	....
China	35,325	35,700
Denmark	114,851	100,335
France	240,225	216,775
Greece	1,500	1,500
Holland	366,581	328,338
Italy	355,241	314,547
Japan	285,676	309,474
Norway	90,449	92,719
Portugal	5,210	5,210
Spain	98,351	107,463
Sweden	118,553	110,765
Total	7,941,950	7,861,363

Of the total tonnage being built in the world at the beginning of April, excluding vessels the construction of which has not actually been commenced and excluding all vessels of less than 100 tons, the total under inspection by *Lloyd's Register* amounts to 4,965,612 gross tons.—*Shipping*, June 10, 1920.

AERONAUTICS

NAVAL RESERVE FLYING CORPS TRAINING.—Admiral R. E. Coontz, U. S. N., Chief of Naval Operations, has approved a plan of the Bureau of Navigation which will allow qualified aviators of the Naval Reserve Flying Corps to indulge in flying for two weeks during the coming summer. The schedule provided for four stations, which will give 60 aviators practice in heavier-than-air and 20 practice in lighter-than air craft every two weeks. The training is to be given in the discretion of the commanding officers at the stations located at Rockaway Beach, L. I., Hampton Roads, Va., Pensacola, Fla., and San Diego, Calif., so as not to interfere with the regular operations of these stations. The schedule is for the exercise of qualified fliers only, for no provisions can be made for the training of unqualified members of the Naval Reserve Flying Corps at this time. Each of the stations will accommodate 15 in heavier-than-air and five in lighter-than-air craft every two weeks. The training will begin July 1, and the officers who apply for active duty for this training will be assigned as follows: First and Third Naval Districts, to Naval Air Station, Rockaway, L. I. Fourth, Fifth and Sixth Naval Districts, to Hampton Roads, Va. Seventh, Eighth, Ninth, Tenth, Eleventh Districts, to Pensacola, Fla. Twelfth and Thirteenth Districts, to San Diego, Calif.

Commandants of naval districts will arrange all the details concerning the training of the Reserve fliers with the commanding officers of the several naval air stations. Periods of less than two weeks' time actually at the air stations for this training will not be considered. Lack of facilities alone makes it imperative that training of any enrolled enlisted personnel, student fliers or other officers and men in the Naval Reserve Flying Corps be not undertaken during the coming summer.—*Aerial Age Weekly*, June 14, 1920.

A FLYING ACADEMY.—When the American flying service really gets into going order, serious consideration will have to be given to the establish-

ment of an academy similar in type and standing to the military and naval colleges at West Point and Annapolis. Since it is certain that in a few years' time the flying service will be of equal importance if not of more importance than the other services, an air college from which men may be commissioned direct into the service after strenuous tests will become a necessity. The practical interest already taken in aviation by the big educational institutions promises well for the future.—*The Scientific American,* July 10, 1920.

NAVAL RESERVE FLYING CORPS OF 2,000.—The Navy Department has decided that the Naval Reserve Flying Corps (Class 5) will consist of approximately 2,000 officers, all of whom must be qualified naval aviators. In order to obtain and maintain the officers the following plan has been adopted: The required percentage of graduates of designated universities and colleges, who have completed a syllabus of training in aviation approved by the Navy Department, and who meet all other requirements defined by the Navy Department, will be enrolled in the Flying Corps as midshipmen. They will immediately be sent to Pensacola, or other naval air stations, for an intensive course of training for three months or longer. Upon completion of the course graduates will be commissioned either as ensigns in Class 5 or will be discharged, according to whether or not they are considered qualified for all the duties of an officer in the Flying Corps. Every officer in the Flying Corps will be confirmed in appointment after graduation and thereafter will be required to take at least two weeks' active duty for training at a naval air station or with a fleet aviation detachment each year.

Facilities will be open at all times to officers of the Flying Corps at all naval air stations to engage in flights at their own convenience. In order to remain in the Flying Corps each officer must have at least 15 hours' actual time in the air each year of his enrollment. There are approximately 1500 qualified aviators in the Naval Reserve Flying Corps. An officer in the corps will not be re-enrolled after he has had eight years' service; therefore, in order to provide and maintain the necessary number it will be necessary to enroll and train about 400 midshipmen every year. Only officers now in Class 5 who are qualified naval aviators and have had less than eight years' naval service will be eligible for re-enrollment. Enrolled enlisted men will not be eligible for enrollment in this class.—*Aerial Age Weekly,* June 21, 1920.

SOMETHING NEW IN THE WAY OF AIRPLANE METAL RIBS.—Extreme altitudes—the objective of Major R. W. Schroeder and aviators of like ambitions—are not to overshadow another problem of aeronautics, that of of multiplying the speed range of airplanes. A new type of airplane rib developed by the United States Bureau of Standards, by varying the angle of attack, is capable of making greater speed than hitherto possible with the prevailing wings.

Described as the Parker variable-camber wing, the newly-designed equipment recognizes the principle of construction that if the angle of attack can be efficiently varied from a very small to a very large angle, a wide range of speeds is possible. The properties of the type of wing usually seen are held responsible for the restricted speed of airplanes.

Among the features of the rib structure of the Parker variable-camber wing are: Deformation regularly with the load up to the unit flying load, then remains rigid under further applications of weight, being strong enough to stand up under several times its normal load without failure. Simple, foolproof and easily manufactured are the virtues claimed for the wing. Metal construction is necessary in the new type of rib; other portions of the machine such as spars, bracing wires, and struts are not altered. The essential parts of the new wing are: channel-shaped strips forming upper and lower surfaces of the rib between the spars; compres-

sion links are of channel section also and fixed to outer channels by pins, allowing necessary angular motion between links and strips; the tension links are flat strips of steel attached to the same pins which carry the compression links.

A radical departure from the prevailing type of wings, these links in stream-line position carry no load, but in a lifting attitude they straighten out and make a truss of the rib, thus preventing further deformation under loads. The links in the first two and last two panels are slotted to permit of the insertion of reserve links. A tail piece is fixed in shape, riveted to the upper strip and constructed to slide over the rear spar. A spring is placed between the rear spar and the tail piece, this spring being used as a tension attachment to the rear spar and the front compression member of the tail piece.—*The Scientific American,* July 3, 1920.

SUPERCHARGERS FOR AIRPLANE ENGINES.—An airplane flying at high altitude is in an atmosphere of comparatively low density. For instance, at 20,000 feet altitude the density is practically half that at sea level. This means that a given volume contains half as much actual air by weight. The cylinders of an airplane engine are therefore charged with an explosive mixture which has about half the value of a charge at sea level. The engine actually delivers about half of its sea-level power at 20,000 feet.

Both the low temperature and the decreased pressure at high altitude have effect in fixing the high-altitude density. Both the decrease of temperature and the decrease of weight of the charge affect the carburetion at high altitude. The fixed clearance volume and the decreased initial pressure give a decrease of compression pressure resulting in a loss of efficiency. There is, therefore, a combination of causes which gives as a net result a decrease in engine power very nearly proportional to the decrease in density. At high altitude the resistance of the air to the motion of the airplane is decreased directly in proportion to the decrease of density. The power required for a given airplane speed is therefore greatly reduced. However, the engine power has been so reduced that the usual net result is a considerable decrease in airplane speed. When the engine power is maintained at the sea-level value, there is, however, a considerable increase of speed at high altitude.

Filling the cylinders of an internal-combustion engine with a charge greater than that which would normally occur, is called "supercharging." Methods of doing this have engaged the attention of a great many experimenters.

The centrifugal compressor is an apparatus similar to the fan blower except that the shape of the impeller blades and the passages leading air to and from the impeller are so arranged as to give an efficiency very much greater than that of the usual type of fan blower, so that the apparatus forms a satisfactory means for compressing air to appreciable pressures. A line of single-stage centrifugal compressors has been developed for compressing air from 2 to 5 pounds per square inch above atmosphere, to be used for many industrial purposes; as well as a line of multi-stage machines for compressing air and gas up to pressures of 30 pounds per square inch above atmosphere.

The turbo-supercharger is a combination of a gas turbine and a centrifugal compressor, arranged as part of an airplane gasoline engine. The hot products of combustion from the engine exhaust are received upon the turbine runner and furnish power whereby is driven a centrifugal compressor mounted on the same shaft, which compresses air for supply to the carburetors. A more detailed description is given later, as well as particulars regarding its development.

In the latter part of 1917 the National Advisory Committee for Aeronautics requested the co-operation of the General Electric Company in the development of the turbo-supercharger in the United States. Our work was originally started at the suggestion of Dr. W. F. Durand, then chair-

man of the committee, who knew of our long experience with gas turbines and centrifugal compressors. It has since been carried on under the supervision at various times of Col. J. G. Vincent, Col. T. H. Bane, Major H. C Marmon, Major G E. A. Hallett and Major R. W. Schroeder. Major Hallett has had charge of the development since the armistice, and he has given considerable study to the matter of superchargers in general.

The Turbo-Supercharger Cycle.—Fig. 1 shows an airplane engine equipped with a turbo-supercharger. The exhaust of the engine is received by an exhaust manifold which leads it to a nozzle chamber carrying nozzles which discharge it on to the buckets of a turbine wheel. On the same shaft as this turbine wheel is the impeller of a centrifugal compressor. This compresses air from the low-pressure atmosphere to approximately normal sea-level pressure and delivers it to an air-discharge conduit which supplies the carburetors.

The turbine nozzles are of such area as to maintain within the exhaust manifold and nozzle box a pressure approximately equal to that at sea level. The difference between this pressure and the altitude low pressure gives a

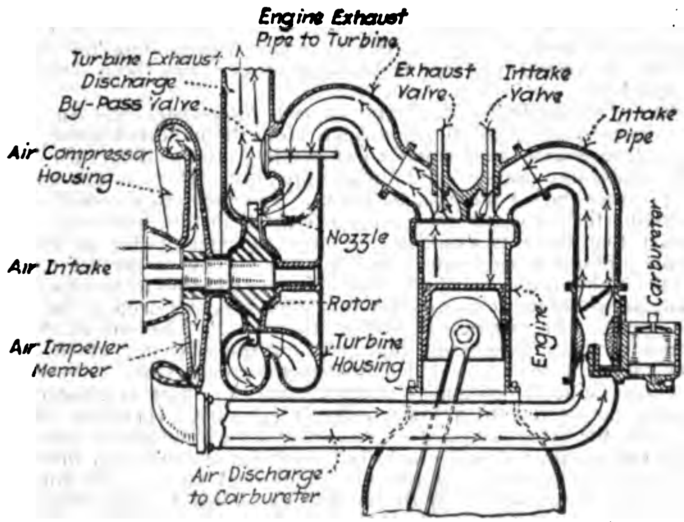


FIG. 1.—Diagrammatic Sketch of an Airplane Engine Equipped with a Supercharger.

pressure drop for the exhaust gases which furnishes the power that operates the system.

Due to the respective temperatures this power input suffices to give the desired compression and also to supply the inevitable losses. However, in order to avoid back pressure on the engine, above the normal sea-level value, both turbine and compressor must be designed with utmost attention to efficiency.

With an efficient arrangement the engine when at high altitude exhausts at normal sea-level pressure and receives its air at the carburetor at normal sea-level pressure. Hence, normal sea-level power is delivered at all altitudes up to the maximum for which the supercharger is designed, so that the plane speed will increase uniformly as the altitude density decreases.

Mechanical Problems of Supercharging.—The General Electric superchargers thus far constructed have been designed to give sea-level absolute pressure at an altitude of 18,000 feet, which requires a compressor

that doubles the absolute pressure of the air. This pressure ratio, with the quantity of air involved, means about 50 shaft horsepower input for the compressor. The design of a complete power plant of this size to suit an existing airplane engine, with such weight and location as will not impair the flying characteristics of the plane, has of course offered many problems. The possibility of driving the compressor of the supercharger by engine power instead of by the exhaust gases suggested itself. Much experience with the operation of the gas turbine, however, led the writer to prefer its problems to those of the driving mechanism of a supercharger operated from the engine. The turbine involves merely the addition to the compressor of a single extra wheel, designed for the conditions, with no extra bearings. The engine-driven scheme involves a 50-horsepower transmission with a multiplicity of gears, bearings, clutches, belts, and the like. These offer more or less drag on the engine when the supercharger is not in use at low altitudes, and very serious problems of acceleration when the supercharger is to be thrown into action, since the engine will be then running at its full speed of about 1800 r. p. m.

The exhaust manifold and nozzle box have proved to be a very efficient exhaust muffler and conductor. Such a muffler and conductor is needed in any event, and the design of means for withstanding the increased pressure difference of the turbo-supercharger has been successfully accomplished.

Power for Turbo- and Engine-Driven Superchargers.—An efficient turbo-supercharger theoretically deducts from the indicated horsepower of the airplane engine an amount corresponding to the difference between sea-level absolute pressure and altitude pressure. There is this additional back pressure during the exhaust stroke. The theoretical power available for driving the turbo-supercharger is greater than this, however, owing to the fact that there is available not only the energy due to the direct pressure difference mentioned, but also the energy of perfect expansion from the higher to the lower pressure. If there were no turbo-supercharger the engine would waste this energy in sudden pressure drop as the exhaust valve opens. The turbine can utilize this energy. The sum of these two amounts of available energy, multiplied by the efficiency of the turbine wheel, gives the shaft power delivered to the compressor.

For an engine-driven supercharger compressor there is greater engine indicated power due to a lower exhaust pressure. However, the shaft power for the supercharger compressor must be transmitted through the engine connecting rod and crankshaft, with losses, and then through the supercharger driving mechanism with additional losses. The total shaft power thus subtracted from the engine, multiplied by the efficiencies of these two transmissions, gives the shaft power delivered to the compressor. This is the same as for the turbo-supercharger. For a Liberty motor of about 400 horsepower and sea-level power at 18,000 feet altitude, this power is 50 horsepower.

The comparison then is as follows: The turbo-supercharger substracts from the engine indicated power, adds power of expansion which would not otherwise be used, and has turbine wheel losses. The engine-driven supercharger puts this indicated power through the engine (with some additional loads on the pins and bearings) and has engine and transmission losses.

With usual efficiency there is probably not a great difference between the gross substraction from engine power in the two cases. There is then the disadvantage of transmitting the supercharger power through the engine pins and bearings, as well as through some mechanism between engine and supercharger, to be compared with the collection of the hot gases under pressure (with muffling advantages) and delivery to the turbine wheel. As already mentioned, practical success to date is in favor of the turbo-supercharger and the writer feels that this is really due to its innate superiority.

Engine-driven superchargers with positive-pressure blowers have been proposed. These have the additional disadvantage that with the desirable pressure ratios of about two to one there is an appreciable compression loss due to the fact that the machine only displaces air and has no direct means for compression.

Supercharging engines of various kinds, in which the engine crankcase or the engine cylinders themselves are arranged for additional compression, have been shown to give excessive weight and complication as compared with a turbo-supercharger.

Development of the Turbo-Supercharger.—The machines used thus far have been designed to give sea-level pressure at 18,000 feet altitude, which corresponds to a pressure ratio of about two. The rated speed for these conditions is 20,000 r. p. m. Sea-level pressure has readily been obtained up to 22,000 feet altitude. The control is entirely by hand operation of waste gates, which permits of free escape of some of the exhaust gases.

The entire apparatus, exclusive of exhaust manifold and air-discharge conduit, weights about 100 pounds. The exhaust manifold and air conduits have nearly the same weight as equivalent parts with no supercharger.

The turbine and compressor wheel have diameters somewhat less than a foot. The present design has been hampered by necessity for accommodation to existing engines and planes. It is proposed, however, to construct apparatus in which engine and supercharger are integral, with all parts arranged for the full possibilities of the combination.

In the combination under consideration the airplane, propeller, engine, radiator, cooling system, and supercharger are so intimately associated that no adequate tests can be made without the complete system in operation at full speed at altitude. During the initial development of the Liberty motor a testing expedition had been sent to the summit of Pike's Peak, and it was decided to repeat this performance with the supercharger. Fig. 2 shows the motor truck that was prepared for the expedition and Fig. 3 the way it was left after each day's work. The Liberty motor carrying the supercharger was mounted on a cradle dynamometer, with scales and all arrangements for accurate measurement of power, gasoline consumption and the like. In fact, a complete testing laboratory was provided. The motor truck was shipped by rail to Colorado Springs, and then proceeded by its own power to Pike's Peak summit on the "Pike's Peak Auto Highway," a well-constructed but very tortuous mountain road 28 miles long. The summit has an altitude of 14,109 feet and it is the highest point in the United States easily reached by road.

The testing work at the summit lasted through September and half of October, 1918. The usual difficulties with experimental work were, of course, encountered with the addition of many delays, due to the cold and snow, and distance from repair shops. The apparatus was finally arranged to give good mechanical operation and it was found possible at the existing altitude of 14,000 feet not only to supercharge so as to give full sea-level power, but also to overcharge so as to cause the engine to preignite.

It was agreed that results of the tests warranted the immediate installation of the supercharger on an airplane, and arrangements for doing this were in progress when the armistice caused a cessation of the work. After the armistice, careful reëxamination of the situation resulted in resumption of the work in the early part of 1919. Various rearrangements were made in view of the experience gained at Pike's Peak and the apparatus was finally installed on an airplane.

It soon developed that a very appreciable increase of power was easily obtained when the supercharger was opened up. The whole airplane installation was not properly arranged to take advantage of this power, however, and changes were necessary in the radiator, cooling system, propeller system, gasoline tank, pump system, etc. Changes in these parts have been made from time to time, and this work is still in progress. As the work

proceeds more and more power is developed by the engine. Changes have also been made in the supercharger itself.

Fig. 4 shows Major R. W. Schroeder, who has made all of the flight tests to date, together with Lieut. George W. Elsey, who has made all of the flight observations to date. The aviators are of course clothed for the intense cold of high altitudes and carry the parachutes that are now regularly used by the U. S. air service in experimental work.

Supercharger Performances.—The supercharger which has been used to date was primarily desired for high speeds at altitudes of 18,000 to 22,000 feet. The Le Pere plane on which the installation was made had a ceiling of about 20,000 feet with two men, and a speed at this altitude of 70 miles per hour. With the supercharger in use, a speed of about 140 miles an hour has been attained at 22,000 feet. As already pointed out, this has been attained with various parts of the plane installation in a partially developed state. Theoretical computations have been made showing that much higher speeds at high altitudes are to be expected, and the flight tests to date indicate that the theoretical expectations will be fully realized.

The making of high altitude records has been very attractive and the supercharger has, of course, been used for this purpose as well as for the speed courses mentioned. Successively higher altitudes have been reached as experience has been gained regarding the manipulation of oxygen, gasoline, and other details.

On February 27, Major Schroeder made a flight alone, attaining an actual height above the ground finally computed as 36,130 feet (6.85 miles). The lowest temperature reached was minus 67 degrees Fahrenheit. At the maximum altitude his oxygen apparatus failed and he became unconscious and lost control of the plane, which fell almost vertically. As he neared the earth he partly recovered consciousness and, at an altitude of about 3000 feet, succeeded, in a half-dazed semi-automatic way, in righting the plane and making a good landing in his own field, again becoming unconscious. He was taken to a hospital in a serious condition, but has since almost completely recovered. The supercharger, engine, and plane were in perfect working order after the flight.

At the maximum altitude attained, recording instruments showed that the plane was still climbing at the rate of about 125 feet per minute and it was estimated that an altitude of 40,000 feet would have been attained if the oxygen apparatus had not failed.

[In the May issue of the *General Electric Review* there also appears a reprint of a paper on Superchargers and Supercharging Engines, by Major George E. A. Hallett, U. S. A., presented at the annual meeting of the Society of Automotive Engineers, January 7 and 8, 1920. Major Hallett, who is chief of power plant division, U. S. air service, deals at some length with the various methods employed in supercharging and refers to the work of the U. S. air service on the Rateau type of turbo-compressor, under the supervision of Mr. E. H. Sherbondy, prior to that undertaken by Dr. Moss. Commenting on the working of the Moss supercharger, he says:

"It would naturally seem at first thought that the extremely low temperatures always found at great altitudes would make possible the easy solution of cooling problems, but in reality the low density of the air reduces its heat conductivity and capacity for heat absorption to such a point that a supercharged engine developing sea-level power at 20,000 feet requires a little *more cooling surface* than it does when developing normal power at sea level.

"The Liberty engine and many others run best with a water temperature of about 170 degrees Fahrenheit. To maintain the cooling water at this temperature in the reduced atmospheric pressure at 25,000 feet it is necessary to use several pounds of air pressure in the radiator to prevent the water from boiling away. Very effective radiator shutters are needed when the engine is throttled to make a descent from altitudes of over

20,000 feet to prevent the water in the radiator from freezing before warmer air is reached.

"Contrary to expectations, the Moss turbo-compressor now being tested at McCook Field does not complicate the pilot's controls. On a normal engine the pilot handles the throttle and the altitude carburetor control which thins down the mixture as he ascends. With the turbo-compressor the altitude control becomes unnecessary up to the altitude at which the engine can no longer deliver sea-level power but is used, as with a normal engine, if the plane is driven higher."

As to the future of the supercharger, Major Hallett says:

"The uses of the supercharger for military service can be divided into: first, for airplanes in which it is desired to reach extreme altitude; second, for airplanes in which it is desired to increase the rate of climb and horizontal speed and therefore maneuverability at altitudes where it is intended to fight; and, third, for airplanes which carry large loads such as bombers, which normally are handicapped by having a very low ceiling and whose entire usefulness would, if larger engines were installed to pull them to a higher ceiling, be lost on account of the large amount of fuel and other material that would have to be carried, thus decreasing their radii of action.

"In the first case it is believed that a special supercharger can be built that will make feasible much greater altitudes than any that have been attained with the present General Electric turbo-compressor; and it is considered essential that we have airplanes, capable of reaching very great heights. In the second case, it is pointed out that military machines not fitted with supercharging engines, when fighting at an altitude of 20,000 feet or more, are so near their ceiling that their rate of climb, speed, and maneuverability are comparatively poor, but the use of a supercharger seems to overcome this difficulty easily.

"The use of superchargers in commercial airplanes of the future is assured because superchargers will make possible far *more miles per hour* and *more miles per gallon* with a given engine and airplane, and speed is the main advantage of air over other kinds of transportation. It is thought by many qualified judges that by flying at a sufficient height with a supercharged engine and a suitably designed airplane, a speed of 200 m. p. h. can be maintained."]—*The Journal Am. Soc. M. E.*, July, 1920.

HELIUM GAS.—The development of a non-combustible gas, of good lifting power, for all balloon purposes, is such as desirable thing, that it is not surprising that the war led to a strenuous effort to separate large quantities of helium from the enormous gas supply in certain fields. Helium has a molecular weight of four against two for hydrogen, hence its lifting power is about 92.6 per cent that of hydrogen. Helium is monatomic.

The Petrolia, Texas, field alone has in the past delivered as much as 30,000,000 cubic feet of natural gas per day carrying as high as 300,000 cubic feet of helium to waste in the furnaces and stoves of the cities of Dallas and Fort Worth. Even greater quantities of gas exist in Ohio, but the helium content is much less.

It appears that natural gas carrying 1/3 to 2/3 per cent helium is available in immense quantities, and it only remains to separate the helium cheaply to make ballooning perfectly safe, particularly against accident from fire.

However, it is no small problem to liquify a gas which may consist of 30 per cent nitrogen, 50 per cent methane and 19 per cent ethane, propane, butane, etc. Fortunately, the remaining one per cent of helium need not be liquefied, since its boiling point is 4¼° C. abs. The nitrogen and methane liquefy at minus 195.66° and 161.7° C. respectively, and these temperatures are not difficult to reach.

Three plants were installed during the war. Two of these were located at Fort Worth, Texas, and both produced some helium at a very high cost, say, from $200 to $300 per thousand cubic feet.

The third plant was located at Petrolia, Texas, immediately at the gas wells, and unfortunately depends on the operation of a privately-owned and operated gas compression and gasoline extraction plant.

The interference of the residual gases, ethane, propane, etc., from the gasoline extraction system, has prevented even a study of the operation of this plant under proper conditions.

It is evident that if the condensing system becomes cold enough to condense nitrogen, for instance, the sudden admission of even methane would at once put the condensing system out of commission, while a gust of ethane would be even worse.

Under the most adverse conditions, as to variable gas supply, the plant has been operated for about one year. Helium up to 20 per cent has been recovered in small quantities, and it only remains to remove the external difficulties and to provide reasonable control over the gas supply to make an increased output and higher purity a matter of natural sequence.

The system used at Petrolia differs from the other plants in that the gas is liquified and distilled at a pressure of 300 pounds per square inch.

Very powerful expansion engines, three in number, expand the gas after separation, and their very cold exhaust serves to refrigerate the interchanger system. These interchangers resemble counter current condensers, and have about 14,000 tubes, and a surface of 8,000 square feet is available to cool and condense the gas.

The stills are essentially of standard type, except that they are maintained at high pressure. As high a ratio as 80 has been reached in the relative helium content of gas treated and the discharge of still.

The economical production of helium depends altogether on the seemingly independent matter of freeing the gas from gasoline vapors.—*The Tech. Engineering News*, June, 1920.

ENGINEERING

Welds and Welding.—There can be no doubt about the attractiveness of "welding" as a means of making joints in metal structures. Its advantages are so obvious and appear to be so great. First and foremost is the advantage of cheapness and convenience; electric and acetylene welding can be carried out not only with much less labor, but with much greater speed and convenience than the older methods of making joints. By comparison, riveting—involving, as it does, the drilling or punching of holes in accurately determined positions, followed by the insertion of the rivets themselves—is a clumsy and a costly operation. From the point of view of the strength of the resulting joint also, riveting is far from satisfactory; only by great care in design and construction can a strength approaching as much as 70 per cent of that of the original bar be obtained, and in most joints the strength is very much less. Further, there are many cases where broken parts can be re-joined by "welding" while riveting is out of the question and other methods are impracticable. It is small wonder, then, that this method of jointing structures by autogenous fusion is finding ever wider and wider application. Its rapid rise into widespread popularity has, further, been very materially assisted by the conditions prevailing during the war, when very rapid repair work, particularly, was rendered possible by the use of arc or blow-pipe, where older methods would have failed us.

When a new method of this kind achieves such widespread and growing application it can no longer be a question of discussing whether it is or is not useful. On the other hand, the question does remain to be considered—and it needs very careful consideration indeed—whether the application of welding methods may not be pushed too far, whether the cheapness and convenience of the method may not lead to its use where such use is undesirable or even seriously dangerous. To discuss the matter from this point of view, and even to insist upon certain important limitations to the

use of welding, is by no means a sign of hostility to the progress of what is really a new industry. On the contrary, the most ardent advocates of welding, and those most directly interested in its development from the business point of view, must admit that it could only do the process serious harm if its use were to be extended to cases where serious harm might result. The occurrence of a few failures, even if by good fortune they should not be disastrous if traceable to the injudicious use of welding, would do more to hinder the useful and sound development of the welding industry than a hundred really successful applications could do to stimulate it. For that reason we would ask those who advocate the application of welding to all manner of engineering structures, and those whose safety depends upon the soundness of those structures, to consider very carefully where and how welding can be safely and judiciously employed. Failing such judicious restraint, a reaction is likely to occur, leading possibly to the imposition of stringent restrictions if it should be found that public safety may be jeopardized. In considering what limitations, if any, should be placed upon the use of autogenous welding it is necessary to consider the character of the weld itself. In the case of a "perfect" weld—that is, a weld free from any unsoundness—there is no doubt that we have a joint in many ways stronger than and superior to a riveted joint, and one possessing at the same time the considerable advantage of being water and steam-tight. But although stronger than a riveted joint, such a joint does not attain the strength of the unaltered material. In the first place, the weld proper consists of steel or iron which has merely cooled down from a state of fusion without undergoing subsequent refining either by work or heat-treatment. Even though such material behaves well under an ordinary tensile test, there can be no doubt that it is much less reliable and satisfactory than properly worked and heat-treated steel. Tests show, however, that this material which has been actually molten is not the weakest part of a sound weld; the weakest area is generally found a short distance on either side of the weld proper, where the adjacent steel has been exposed to that temperature which leaves it in the weakest and softest condition. It is, of course, true that even in this softened, weakened condition, the steel may be amply strong enough to bear the stresses coming upon it; but this weakening, and particularly the lowering of the elastic limit, requires careful consideration by the designer who intends to rely on welded joints in his structures.

The most serious difficulty in the use of welded joints where the main stresses of a structure have to be borne arises from the fact that it is not only difficult to produce sound joints, but that it is practically impossible to tell by examination whether a given weld is or is not really sound. Cases of failure having more or less serious consequences are of increasingly frequent occurrence at the present time, where the trouble is directly traceable to a defective weld. In some of these cases careful inspection would at once have thrown serious doubt on the adequacy of the weld, but in other cases the defects are entirely covered and can only be seen when a section is cut through the weld or its two parts are torn asunder in servcie. Careful workmanship and rigid inspection can no doubt serve to reduce risks of this kind, but it is at least open to very serious question whether a process which is undoubtedly liable to this danger should be employed for making joints of primary importance exposed to heavy working stresses. Even during the war the risks involved in the use of welded joints in aeroplane construction were fully recognized, and the use of the process for that purpose strictly limited. But even where, in the repair of boilers and bridges and in the construction of ships it was rightly regarded as a legitimate war risk to employ electric or acetylene welding even for vital parts exposed to main stresses, it is another matter to adopt the process broadcast for the regular uses of peace time. The improvement in the methods of welding and in the knowledge of the materials welded and the increase in the skill and experience of welders may in time put the

process beyond all doubt. But we have not reached that stage yet, and until we do, it is advisable to move slowly and not to be deflected from a cautious path by the remarkable successes already attained.—*Engineering*, June 25, 1920.

OBTURATORS IN INTERNAL-COMBUSTION ENGINES.—*Obturators versus Piston Rings.*—Experiences in air-cooled engines on aircraft led in some cases to the replacement of the ordinary piston rings by an obturator, which is essentially the equivalent in metal of the cup leather used for packing hydraulic cylinders. The air-cooled cylinders of rotary engines, it was found, suffered distortion when at work owing to the leading side of the cylinder being more effectually cooled than the trailing side. As a consequence, piston rings often failed to hold the pressure satisfactorily. Any increase in their number would have involved a longer and heavier piston, and the obturator was introduced in consequence. This, as explained in an interesting and valuable paper by Mr. W. Fennel, M. I. E. E., which was read at a recent meeting of the Diesel Engine Users' Association, consisted of a flexible L-shaped ring forced against the cylinder wall by fluid pressure. At the outset the life was short, but improvements made at the works of "Engineering and Arc Lamps" increased the life from 10 hours to 60 hours, and in exceptional cases to 250 hours. Brass was the metal first employed, but a special phosphor bronze is now used. The obturator was placed near the top of the piston, but being flexible and forced by the pressure into close contact with the relatively cool wall of the liner, it did not burn. Nevertheless, it is now considered preferable to fix it some little distance below the piston head. As originally fitted the rings were split similarly to a piston ring, but a lap joint is now used and with this the obturator works well, even if the liner be worn out of true. In consequence of the satisfactory behavior of these obturators, Mr. Fennell determined to fit one to a three-cylinder Sulzer-Diesel engine rated at 140 horsepower. The liners of this engine had worn badly, being far from circular and tapering to the extent of 0.1 inch. It was impossible under the conditions to obtain new liners, and piston rings failed so rapidly the engine could not be run save at a prohibitive cost. It was decided accordingly to fix the three top rings of the piston and to place an obturator in the fourth groove. After a run of 100 hours without loss or blowing by, the obturator was examined. The wear was less than one mil, and the engine was set to work again, without replacing it. This obturator lasted 380 hours and then failed, due to wear at the lap joint. Here the motion was considerable, owing to the taper of the liner. Further experiments showed that even with these badly-worn liners the obturator might be counted on to last 300 hours, which was longer than the piston rings would stand. Further tests, Mr. Fennell stated, are in progress, and they indicate that with the liners in proper condition the life of the obturator should be well over 1000 hours. *Engineering*, April 16, 1920.—*The Journal Am. Soc. M. E.*, July, 1920.

INCREASE IN MOTOR SHIPS.—It may be a matter of general interest to know that there are at the present time no fewer than 150 motor ships being built, representing in cargo capacity over one million tons. Statistics regarding the number in use give an adequate idea of the extent to which the motor ship is supplanting old and familiar types. There is no need at this stage to discuss the advantages claimed for the motor-driven vessel in comparison with the steamship. These are known; the disadvantages are also recognized. It would be futile, of course, to expect the same reliability of operation in the case of the marine internal combustion engine in the sizes required for ocean-going ships to that which is associated with steam propelled vessels. In spite of the considerable advances which have been made, there are still problems which have to be solved before the majority of shipowners will be persuaded to turn their backs upon the steam engine and adopt the internal combustion engine for purposes of ship

propulsion. The argument which is sometimes used, that the space required for fuel storage in the case of the marine motor is very much less than that required for the storage of coal, scarcely applies to-day, when so many vessels are being fitted to use oil instead of solid fuel under boilers. Those who are interested in the progress of the motor ship need not, however, entertain any fears that the subject is not rated at its full importance by our shipbuilders and marine engineers. Some of the leading shipbuilding and engineering firms are not merely "standing-by," awaiting for a new development, but are allocating considerable sums to the investigation of the features which underlie successful design. Work on the evolution of the best type of motor for purposes of ship propulsion is in hand, and, as one or two recent installations have indicated, some notable results have been achieved. In spite of the lead gained by German manufacturers in the field in the pre-war period, we need not imagine that we are going to do anything in the future but show the way in developments in this field.—*Shipping,* May 25, 1920.

THE SOLID INJECTION OIL ENGINE.—The air compressor, be it a direct-connected or a separate unit, furnishes a large percentage of the Diesel-engine troubles. The pressures and conditions under which it operates are such that lubrication is difficult; valves often leak and packing troubles are always present. Furthermore, since considerable quantities of air are employed in the injection of the fuel charge, the power demands of the compressor range from 6 to 10 per cent of the horsepower developed in the engine. Many Diesel designers have attempted to eliminate the compressor, but with little success. Where the engine on the Diesel cycle, the injection of oil occurs a considerable period of the power stroke, and it is necessary to have some means whereby the pressure in the fuel-oil lines can be kept constant during the period of injection.

The Vickers Co., of England, several years ago abandoned the air blast on their Diesels and now make use of a fuel-injection system having a flattened steel tube to maintain the oil pressure. This design apparently is very successful since many Vickers Diesels are in daily service in the British navy and in the merchant marine.

The explosive, or constant-volume, oil engine does not require a constant oil-line pressure nor the somewhat complicated fuel-valve mechanism of the Diesel, and it is to this type of engine that the solid injection principle is most adaptable. The one feature with the solid injection engine that requires the most careful designing is the atomizer, or injection nozzle. Since there is no air blast to break up the fuel, the atomizer must do this mechanically. In fact, the oil must be atomized in a more perfect manner than necessary with the air-injection engine. Furthermore, the nozzle must handle the oil without the dribbling effect so prevalent in hotbulb designs.

In the Diesel engine it has been customary to employ a compression pressure ranging from 450 to 600 pounds per square inch. Those engineers accustomed to these pressures are under the impression that with the lower pressures encountered in the explosive engine the temperature will be entirely too low to cause auto-ignition. It then appears unreasonable to operate an engine having a compression pressure of 200 to 300 pounds without a hotbulb or other ignition device. The following explanation is given with the idea of clearing up this question.

It has been proved that a fuel will ignite at a temperature well below 800° F. provided it is atomized or broken up to allow each minute oil particle to be in contact with the necessary amount of air. It is apparent that two things are required—thorough atomization and proper temperature. Fig. 1 is a curve showing the relation of temperature and pressure where the compression is adiabatic. This curve is based on the equation,

$$\frac{T_1}{T_2}=\left(\frac{P_1}{P_2}\right)1-\frac{1}{n}$$

T_1, the temperature at the beginning of compression, is here assumed to be 212° F. When the engine is warmed up, this value is about correct, although on starting cold, T_1 will be somewhat lower. The exponent n is assumed to be 1.35 instead of 1.41, with the intention of making allowance for the loss to the cylinder walls during compression.

The temperature with 300 pounds final compression pressure is approximately 1050° F. This is amply high to ignite any of the fuel oils. The Diesel engine, with its large radiating surface relative to its compression volume, experiences a loss of temperature that is much greater than in the

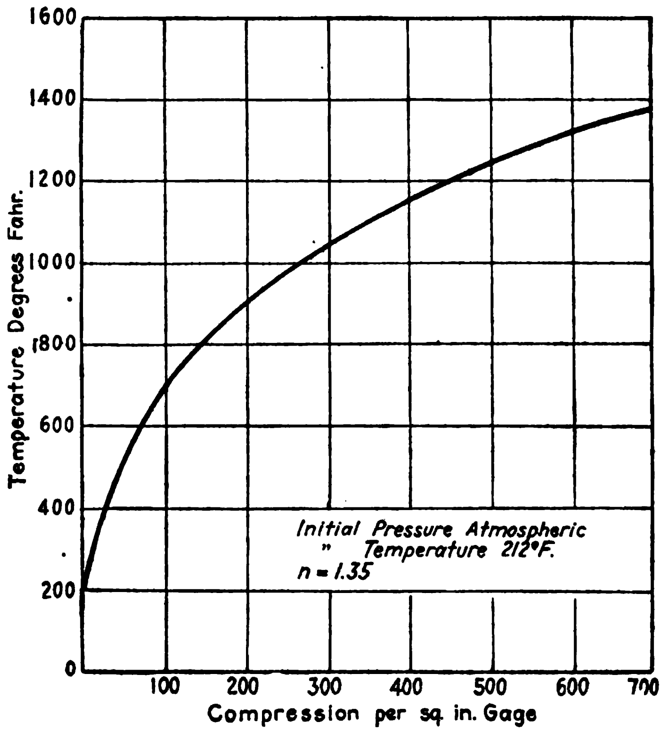


FIG. 1.—Curve Showing Relation of Temperature and Pressure Where Compression is Adiabatic.

case of the solid-injection engine having a combustion chamber with a large volume and a small radiating surface. It is quite likely that the chilling effect of the expanding air blast in the Diesel causes a drop of at least 150° F. in the temperature of the air and oil. As a practical example of the ability to operate at 300 pounds, many operators are running old Diesels with a still lower compression.

As has been stated, the curve in Fig. 1 is based on an initial air temperature of 212° F. On starting a cold engine, this value is much too high; if there is no throttling of the air, it should be around 70° F. This would give a final temperature of about 725° F., which is sufficient to ignite a well-atomized fuel charge, although the first few explosions will probably smoke badly. To secure thorough atomization and ignition, it is necessary

that the oil be broken up without any part striking the relatively cold walls of the combustion chamber. This has led to various designs of combustion chambers as well as atomizing devices.

In this discussion no consideration has been given to the effect the injected oil has on increasing the pressure and temperature of the mixture in the combustion chamber or to the time element as applied to the period of vaporization of the oil. There is no doubt that both these factors have marked influences on the action of the engine.

The timing of the injection of the fuel varies in different makes of engines from 40° to 6° ahead of outer dead center. The operator of a Diesel knows from experience that an injection point much over 7° ahead of dead center will produce marked preignition; in the hot-bulb engine an injection point of 30° will cause severe pounding unless water injection is employed. In the solid-injection oil engine it has been found that the timing is largely dependent on the compression carried. If the compression is as low as 200 pounds as in the Price engine, the injection must be earlier than 30° to give ample time for the vaporization of the oil, while with 300 pounds pressure, as with the De La Vergne S. I. engine, the injection is not over 6°. To avoid danger of preignition at early injection periods, a combustion chamber is placed in the head. The oil is injected into this space where it mixes with the air. Since the major part of the air charge is contained within the cylinder, the amount of air in the combustion chamber is not sufficient to produce ignition even with a sufficiently high temperature. Ignition can occur only when the moving piston forces the main air charge into the combustion space.

The fuel consumption per brake horsepower is low; in many cases it equals the best Diesel results. Since the compression is much lower than with the Diesel engine, the thermal efficiency based on indicated horsepower is not as good as with the latter engine. The extremely high mechanical efficiency, due to elimination of the air compressor and lower frictional loss, is responsible for the excellent fuel economy.—*Power*, June 29, 1920.

NAVIGATION AND RADIO

THE RUSSELL-RANKEN STEERING RECORDER.—The question of good steering, in addition to being of vital importance to the safety of a vessel, also greatly affects economy of propulsion by the maintenance of a steady course, while there is also the question of economical use of power for the steering engine. A recent series of tests on a large modern steamship showed surprising results in regard to different helmsmen. It was found that the best helsmen made 85 movements of the steering wheel per hour, and the worst 565. A device, therefore, which records the steering operations, and thus enables investigation of them, has possibilities of great practical usefulness. Such a device is available in the Russell-Ranken steering recorder illustrated in figure, which records graphically, without need of subsequent plotting or calculation, every movement of the helm, at the same time registering the hour, the minute, half-minute and quarter-minute. It shows the amount of helm to port or starboard, the length of time taken to operate the rudder, and the length of time it remained in a stationary condition.

The recorder may be connected to either the controlling shaft of the steering engine or to the rudder-post, and, depending upon which of the plans is adopted, the position of the instrument may be either aft in some suitable position, or on the bridge.

The instrument is a combination of three main features, viz.:

1. A slide carrying the marking device, and attached either to the rudder-post or to the intermediate fore and aft shafting between the engine and steering gear.
2. A clock, having combined with it an automatic recording apparatus.
3. A clockwork mechanism operating the paper.

Each of these mechanisms operates free of the others. The paper is speeded at approximately one-half inch per minute; but as the paper is automatically stamped by a mechanism controlled by the clock, the approximate time of any recorded movement may be at once read off without taking the speed of the paper into account. A movement of one-half inch per minute of paper is calculated to give a clear diagram, that is, transverse lines made by the pen will not overrun one another, and they will be suffi-

RUSSELL-RANKEN STEERING RECORDER.

ciently far apart to give a clear indication of the length of time the rudder remained stationary. The paper may be ruled lengthwise with a black central line, and red lines to indicate differences of five degrees to port, and green lines five degrees to starboard; or if plain paper is used, the number of degrees may be at once determined by use of a transparent scale, laid off against one edge of the paper.

The instrument is contained in an air-tight case, arranged horizontally, the case being in plan 20 inches by 20 inches by 12 inches deep, with a receiver below to contain the record after it passes the friction rollers which draw the paper over from the "stock" roll.

The face plate carries, in addition to the face of the recording clock, a scale and pointer, which is a duplicate of that on the steering pedestal fitted on the bridge. Both the clock mechanisms are wound from the face plate, and all that is necessary in starting the machine is to wind the clocks, see the recording clock is set at the correct time, and set the recording pen regulator so that its position coincides with the pointer on the scale.

By thus having an exact record of every movement of the helm, a spirit of interest and competition should become general among the various quartermasters and helmsmen, erratic or careless steering would be brought to notice as well as good steering, and a higher state of proficiency reached.

Another advantage is the complete record available of the doings of the steering gear, information which, in collisions and other incidents in ship-handling, it is often very desirable to bring forward when legal or other proceedings are resorted to.—*The Shipbuilder.*

PITOT TUBE ADAPTED TO USE AS NAVIGATOR'S LOG.—The navigator log is a Swedish invention and is being placed on the American market by the American Navigator Log Corporation, Park Row Building. The device is based on the principle of the Pitot tube and is simple in operation. The business end of it protrudes vertically from the bottom of the vessel and consists of a hollow tube with two passages. Near the end of the tube are two holes, one facing the direction in which the ship is traveling, and the other opening on the side of the ship. A passage through which the water flows leads from each hole to the mechanism immediately inside the hull.

The hole facing towards the ships bows registers the water pressure produced by the speed of the vessel, while that on the side gauges the hydrostatic pressure, or that resulting from the draft of the ship. The pressures record themselves upon a membrane in an indicator located in the engine-room, which measures the difference between the speed and draft pressure of the vessel and thus determines her speed. From the engine-room indicator there is conveyed to a second indicator on the bridge by means of an electric current a registration of every knot traveled by the ship. The officer on duty is thus able to tell not only how fast his ship is traveling, but also the total number of knots the ship has traveled since the indicator was set.

The log is said to begin to act as soon as the vessel is set in motion and to indicate with the greatest precision both the speed of the vessel, as well as the distance traveled. It further begins to register at very low speed (1 to 1½ knots), and acts independently of all external conditions, such as changes of temperature, the draft of the vessel, the rolling and pitching of same, etc.

The apparatus is well protected and easy to instal. When once in place it requires little attention. Nor does it call for frequent adjustments, refilling, winding, etc. It is of small dimensions, weighing only 80 pounds. One of these logs has been installed on the United States Shipping Board steamer *Huron.*—*The Nautical Gazette,* June 19, 1920.

WIRELESS HALFWAY 'ROUND THE WORLD.—The Lafayette Radio Station, situated 11 miles southwest of Bordeaux, France, the most powerful radio station in the world, has just been completed by the United States Navy and turned over to the French Government.

The erection of a super high-powered radio station in Europe was the result of a decision made by a military committee called by the Navy Department, which met at New London, Conn., October 4, 1917, and constituted part of a general programme adopted for the improvement of transatlantic radio facilities. It was felt a substantial transatlantic radio service was needed in the event that enemy depredations might destroy or impair communications by cable.

After several preliminary discussions it was agreed that the French Government would furnish a suitable site in France, properly protected, and would erect and furnish buildings, foundations, a water supply and power facilities. The Navy Department agreed to design the plant supply and erect the towers and to install equipment in complete operating condition.

In view of the small size and inadequacy of the existing European stations (Eiffel Tower, Lyons, Nantes and Rome), it was realized that the new station would have to carry an immense volume of traffic in the event that the entire communication burden should be thrown on the radio service; so it was decided to design a plant larger than any in existence.

Signals from European stations were studied, and it was found that even a station as powerful as Nauen (which had been greatly enlarged by Germany during the war) would not be able to give proper service during periods of the day when fading and static combined to produce the most unfavorable conditions.

Alternator equipment for producing radio high frequency currents had not been satisfactorily developed in this country at the time the design of the plant was undertaken and the selection of apparatus narrowed down to the only type which had been demonstrated as entirely successful, namely, the Poulsen arc. The navy was well informed regarding transmitter types, and a contract was placed with a responsible concern for the radio equipment which was to be rated at an antenna current of 550 amperes with an antenna effective height of approximately 600 feet. This design involved an arc converter and power machinery of a capacity between 1000 and 1200 kilowatts. The apparatus was to be furnished in duplicate throughout to avoid any possibility of failure.

While these arrangements were being made the Bureau of Yards and Docks completed designs for an 820-foot three-legged self-supporting steel tower similar in type to the Eiffel Tower. The Eiffel Tower, however, weighs about 2700 tons while each Lafayette towers weighs only 550 tons.

In fact the Lafayette towers, eight in number, are the real engineering marvel of the plant. Their three legs rest on large circular concrete platforms which in turn rest upon a series of concrete "feet" placed upon planks sunk deeply into the ground. The sturdy towers are quite capable of carrying elevators and the French have already considered their installation.

Because of the difficulty of carrying on work over seaes by contract, it became necessary to organize a military detachment to erect the station, particularly as the French Government was desirous of carrying on all such work under a military establishment. Through the co-operation of the Bureau of Navigation, Navy Department, a special recruiting party was organized and a detachment containing nearly 600 steel workers, bridgemen, electricians, and all others required (cooks, yeomen, etc.), was sent to the selected site in the spring and summer of 1918, and began work under the supervision of the Bureau of Steam Engineering, Navy Department.

In order to cope with the transportation problem, special officers were stationed at Philadelphia and at Bordeaux to personally supervise shipments. The duplicate radio equipment parts were forwarded on separate vessels to avoid possible loss by submarining, and it is to the credit of the transport service that no material was lost.

Practically all the tower steel and radio equipment was on the station site in September, 1918, an incredibly short time after the inception of the project, together with a complete erection crew and camp. At this date, however, the French had not yet started on the radio buildings or power supply and were just commencing on the tower foundations. The detachment, therefore, had to erect a temporary power-transmission line and furnish a water and drainage system. The officer in charge urged more rapid progress on the part of the French authorities regarding their portion of the work, with the result that several towers were partly under way on the date of the armistice, although nothing could be done toward installing the radio

equipment. At this time the rainy season in western France commenced and all progress ceased.

The withdrawal of our military forces from Europe early in 1919 made it necessary to disband nearly the entire detachment, the members of which were returned to the United States. The skeleton of an organization was retained at the radio station, however, and an agreement was finally consummated with the French Government whereby the Republic of France contracted to purchase the Lafayette station on condition that the navy would complete it. Work again proceeded, therefore, in June, 1919, the tower erection being taken up by an American contractor, and the remaining work undertaken by the navy, utilizing labor from the New York Navy Yard and elsewhere.

The incoming power supply is 3-phase alternating current of 11,000 volts and 50 cycles frequency. The 1000 kilowatt, 1200-volt direct-current generators are driven by synchronous motors with direct-connected exciters for both motors and generators. Special 20-kilowatt direct-current motor-generator sets are provided to excite special field-winding on the arc converters, designed to enable accurate adjustments of the field flux density to be made.

These windings are arranged so as either to assist or to oppose the effect of the usual series windings, which also exist.

The antenna system is of an extent far exceeding that of any existing radio system. The eight 820-foot towers are arranged in two rows of four each. The rows are spaced 1320 feet apart, and the towers in each row are 1320 feet apart, making a plot approximately a mile long, a quarter of a mile wide, and containing 5,227,200 square feet.

The power house is located in the center at one end of the aisle formed by the two tower rows. Triatics stretching across this aisle between pairs of towers support the longitudinal antenna wires, which are of number three silicon bronze cable.

A special problem arose in connection with the insulation of this antenna because of the extremely high mechanical loads which the triatics are required to carry, but a special porcelain tubular insulator was eventually developed having a length of about ten feet with a mechanical ultimate strength of over 15 tons and an electrical flash-over voltage when dry of about 190,000 volts at a frequency of 50,000 cycles.

The largest station previously constructed by the navy is the one at Annapolis, Maryland, which can deliver a maximum output of 168,000 ampere-feet, whereas the Lafayette station should be capable of delivering 330,000 ampere-feet with more on overload. The maximum wave-length of the Lafayette station will be about 23,000 meters.

From these facts it is evident that the Lafayette station, and it is quite appropriately named, will be practically twice as powerful as any radio station now in existence. It will be capable of transmitting messages approximately 12,500 miles or halfway around the world.

France has a colony at Noumea, New Caledonia, which is just about halfway around the world from Bordeaux. Messages from Bordeaux will reach New Caledonia from both directions, which will probably develop some interesting scientific data.

The present plan is for the Lafayette station to transmit at the rate of 50 words per minute, or 72,000 words per day. Sending messages at such a high speed by hand continuously is out of the question, so the signalling will be done by a mechanical device through which a narrow tape is run bearing the dots and dashes previously perforated by a special kind of typewriter made expressly for the purpose. There are few radio receiving operators who can handle incoming messages at this speed for hours at a time, no matter how expert they are, and to meet this contingency, as well as to guard against errors, it is said that the French intend to equip their stations throughout the world with mechanical receiving apparatus that will make phonographic records of incoming messages. These records may afterwards be "played" over more slowly and transcribed.

Practically all of the great nations now have powerful transoceanic radio plants. Norway has, at Ullenhaug near Stavanger, a transmitting station using tape sending machines. There are ten 400-foot masts in pairs holding an antenna of 24 wires. The power is 300 kilowatts, and the normal sending wave is approximately 10,000 meters. This station sends to America, while its mate, at Naerland, 20 miles south, does the receiving, using the phonographic roll method. Its antenna is held by eight iron masts 300 feet in height.

The Lyons radio station, the largest French station previous to the construction of the Lafayette station, uses apparatus orginally intended for a plant in Indo-China. Eight towers, six of which are 590 feet high and two 787 feet high, carry an antenna in a sheet 2952 feet long by 492 feet wide. The wave-carrying capacity of Lyons is approximately 6210 miles on a power of 150 kilowatts. It is reported that Shanghai papers get their daily news from the Lyons station, and that messages from this station have been heard distinctly at Guam, in the Ladrone Islands, 7452 miles distant.

Back in 1913 there were 560,000 cablegrams handled between the United States and Japan. This number jumped to over 3,000,000 in 1917 and touched the 5,000,000 mark the following year. It is reported the Japanese are constructing a very powerful radio station in northern Japan for commercial use. At present their navy radio plant close to Funabashi is giving a few hours daily to transpacific radiograms most of which are sent to Hawaii for further relay to the United States. Funabashi is powerful enough, however, to work direct with San Francisco, when atmospheric conditions are favorable. The normal working wave of this big plant is about 7000 meters. The station compound takes up about four acres of ground. A triangular pillar 787 feet in height is in the center, and ranged in a circle around it at a radius of close to 360 feet are 16 secondary square pillars 196 feet high. The antenna wires radiate from the central tower to the secondary pillars like the ribs of a colossal umbrella.

In the United States the Naval Radio Station at Annapolis, Maryland, is probably the most powerful. Its four towers form a square and they are 620 feet in height. The radius of action is normally 6,500 miles under a power of 500 kilowatts.

Germany has two big radio stations, Nauen and Eilvese. Great Britain has a monster plant at Carnavon, Wales. Italy can radio to America from Coltano, and Spain has apparatus by no means tiny at Aranjuez which is worked through a distant control wire at Madrid. These facts and figures serve merely to give a general idea of the radio system of the world and to emphasize the magnitude of the Lafayette station.

Our army and navy will leave many monuments in France as a record of our participation in the World War. Among these monuments the Lafayette Radio Station will be one of the most striking and useful.—*The Scientific American*, June 26, 1920.

THE THERMOIONIC TUBE.—The thermoionic tube or valve has become an instrument of such wide utility that the lucid exposition of its principle, which Professor W. Eccles, D. Sc., of Finsbury Technical College, gave last April in two Royal Institution lectures on "The Thermoionic Tube as Detector, Amplifier and Generator of Electric Oscillations" will be welcome to our readers. Every substance, he explained, emits electrons when heated. The mechanism resembles that of ordinary evaporation: but the electrons carry electro-negative charges, whilst the evaporated molecules are uncharged. The phenomena are complex in gaseous atmospheres, but simple in high vacua. When we apply an electromotive force E. M. F. to two electrodes facing one another and heat the cathode, a stream of electrons will flow from the cathode to the anode, *i. e.*, in the opposite direction to the old conventional current (see Fig. 1 and also Fig. 2, on page 1359), the thermoionic current rising as we raise

the temperature in a steep curve (Fig. 3). A heated tungsten filament will hardly emit electrons below 2,000° C.; above 2000° the current increases rapidly, reaching at 2500° 200 times its value at 2000°. In the Fleming valve or diode the anode is a cylinder surrounding the tungsten filament of a lamp, and the diode is used as rectifier, the current travelling only in the direction mentioned. Dr. Eccles exemplified this by reversing the key in the battery circuit by hand, about five times per minute, when the galvanometer deflections were always to the right—never to the left. Since now the current is carried by the small electrons, practically devoid of inertia, the valve can likewise rectify currents of 10,000,000 reversals, per minute. But the curve of Fig. 3, which turns level, and Fig. 2, will help to show that temperature and electromotive force applied have to be adapted to one another. With a low E. M. F. of 55 volts, *e. g.*, the current will cease to increase when we raise the temperature above a certain value, of 2300°; we pass then to the flat maximum of the curve. It is true that we can liberate more electrons by heating the filament to a higher temperature. But these electrons are not emitted at high speeds; they gather near the cathode and, being all electro-negative, repel one another, so that their further liberation is stopped. This "space charge," due to the neighboring electrons, will not shift a particle midway between the electrodes, but will tend to drive an electron near the cathode back into the cathode, and drive another one near the anode upward towards it (Fig. 2), unless we overcome this space charge by applying a stronger E. M. F. The more positive we make the upper electrode, the more the zero position (between the electrodes) will be shifted towards the cathode. Starting with a battery current of 150 volts, Dr. Eccles could reduce the volts to 52, without diminishing the galvanometer deflection by more than 2 divisions, from 25 to 23. That showed that the current was on the level portion of the curve (Fig. 3) in the saturated condition, in which all the electrons emitted are utilized. A valve used in this condition served as a limiting device safeguarding the apparatus to which it was coupled; the current would not rise above the maximum corresponding to the level portion of the curve. To make the valve more sensitive to fluctuations in the E. M. F., we should try to work on the rising straight portion of the curve, a result which in this case, the lecturer remarked, would be obtained by raising the temperature of the filament.

Value of the straight curve was, however, better seen in the case of the triode, which contained a third electrode, the "grid," between the anode and cathode. The grid may be a wire bent to the shape of a grid, or a spiral, surrounding the filament. The diagram, Fig. 4, shows the parts of the triode [within a circle] and the rather complicated connections. The upper electrode, the anode, is joined to the main battery, and this circuit is known as the anode or plate circuit; the grid is indicated by the dotted line; the cathode or filament circuit comprises the small battery heating the filament. When the grid and anode are directly connected the triode becomes a diode. The advantage of the grid is that it enables us to alter the space charge. When the grid is made positive, it eliminates the repulsive force between the electrons, facilitates their emission and increases the current; when made negative the grid reduces the emission and the current is decreased, the point being that one grid volt is able to cancel x plate volts, the x increasing as the grid is approached to the cathode.

With the aid of a galvanometer in the external circuit, Dr. Eccles demonstrated that the addition (or cutting out) of one dry cell to the grid circuit had the same effect as the addition of 6 cells to the plate circuit. The triode, he said, was used for the amplification of the current input on the constant current system, the constant voltage system, or (more generally) by combinations of the two systems. By coupling 20 triodes in cascade, each giving an amplification of 10, the total magnification obtained would be 10^{20}. The regulation could be effected by transformers as well as by resistances, the coils acting largely as choking coils. Since

the grid required little current to feed it, the triode was very convenient to get over the difficulties of bad contacts. Dr. Eccles exemplified this by an experiment ascribed to Edison. A contact is made by approaching a lighted cigar or a match to a strip of ebonite which bends under the influence of heat; the effect was much more striking when afforded another illustration of the power of the triode. In this device (due to the present Lord Rayleigh) a small radium tube and a small metal-foil electroscope are enclosed in an evacuated bulb; the radiations charge the electroscope, the expanding leaves of which touch contacts in the bulb; when one of these contacts was joined to an amplifier, the discharge became audible.

Since the expenditure of small energy in the grid circuit liberates large energy in the plate circuit, the triode can also be utilized in controlling devices. A master pendulum inducing minute current oscillations in the grid circuit can sustain the oscillations of another pendulum of the same period through the aid of an electromagnet in the plate circuit. Fig. 5 illustrates a novel alternating-current motor of Dr. Eccles, based upon this principle. There are two electromagnets, I in the grid, II in the plate circuit; between them rotates an ebonite wheel set with contacts or teeth. When the motor is turned and a tooth approaches I, the current induced is magnified in II, enabling II to pull the next tooth round; the effect is repeated when a tooth recedes.

The small motor exhibited was not self-starting, but when brought up to speed by hand it keeps its speed, and Dr. Eccles has found it very convenient for producing currents, of variable, but constant frequency for testing purposes; the alternating currents may be branched off from terminals in the plate circuit or from a transformer coil. The motor is probably the first of its kind working without slip rings or commutator; the sparking of the commutator would seriously interfere with any delicate testing of high-frequency apparatus.

In another device Dr. Eccles had replaced the motor wheel by a tuning fork, electromagnet I being above the one prong, II below the other. But any oscillating device may be coupled with a triode to produce amplified electric oscillations, and Fig. 4 already mentioned exemplifies the connections of a coil for this purpose. The ends of the coil are joined to the grid and the plate circuits, the middle of the coil being connected to the filament. The oscillations act upon the grid and are themselves acted upon by the fluctuating plate current. There was no outward sign that Dr. Eccles' coil was really oscillating. To prove it, he approached a similar coil circuit, containing a crystal detector (serving as rectifier for the induced currents) and a galvanometer.

Of more practical interest was the other demonstration by the "heterodyne or beat method." When two oscillating circuits are tuned to nearly the same frequency, 500,000 oscillations per second the one, 500,100 oscillations the other, the second circuit comprising a rectifier and a telephone, the telephone will give the difference (or beat) note of $d = 100$ oscillations per second. It is essential that the currents should be rectified as well as amplified, and that is secured by the arrangement illustrated in Fig. 6. The additional devices shown are (apart from the telephone) a small condenser and a high resistance in shunt to it, both in the grid circuit. Electrons can accumulate in the condenser only when the grid is positive; that accumulation, however, turns the grid negative and would diminish the plate current, if the resistance mentioned, the "grid leak," did not allow the negative charge to escape so that the plate current can rise again. The frequency of the oscillations now can be varied by altering the capacity. When the frequency difference d amounts to thousands of oscillations per second, no sound will be heard; as we increase the capacity in the one circuit, the d will decrease, and the sound will become audible; when we come down to $d=30$, the sound will be inaudible again. The audibility will depend upon the listener and his age and upon the kind of telephone, and the listener can adjust the pitch to his own liking. If we

increase the capacity beyond the perfect tuning adjustment where $d=0$, the sound intensity will become stronger again, and the position inter-

TRIODE OSCILLATION SET

Fig. 1.

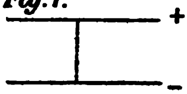


Fig. 2.

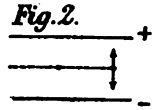
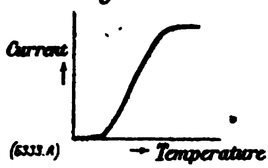


Fig. 3.



OSCILLATION WITH CUMULATIVE RECTIFICATION FOR BEAT RECEPTION.

Fig. 4.

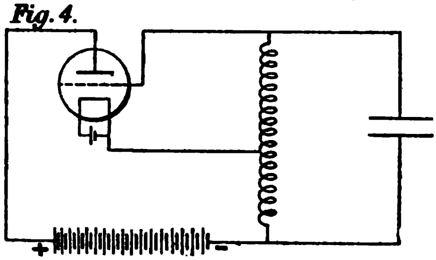


Fig. 5.

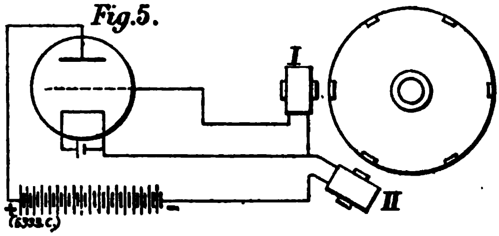
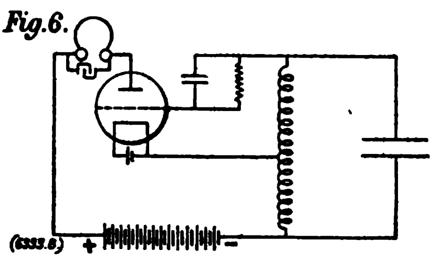


Fig. 6.



mediate between the positions of maximum intensity will mark the capacity for perfect tuning.

The extraordinary sensitiveness of such oscillating coils, especially if of small dimensions, to intentional or accidental slight changes in the capacity or inductance was demonstrated by Dr. Eccles, and its various utilisations were explained. When a piece of apparatus or simply a piece of wire, particularly if forming a closed ring, was brought near one of the oscillators the pitch of the telephone hum at once changed; even the mere movement of the hand of the experimenter had a pronounced effect. When radiotelegraphic appliances are coupled for heterodyne receiving, it may hence be sufficient to give Morse signals by moving a small wire loop instead of working the key. On the other hand, such a pair of oscillators can serve as a delicate induction balance. A small loop of copper wire had a stronger effect than a loop of iron wire. Taking a condenser made up of two vertical zinc plates standing in a glass cell, Dr. Eccles held an open bottle containing ether over the cell; the sinking vapor (heavier than air) affected the capacity and the note. The insertion of a piece of ebonite or paper, or of a gas flame between the condenser plates would produce similar or opposite effects. The thermoionic valve works with electrons. From the energy point of view it is still very inefficient; but it does wonderful things by simple means.—*The Engineer,* May 28, 1920.

HOT-WIRE TELEPHONES.—Thermophones are actuated by heat instead of electro-magnetism, and hence their characteristics are different from those of the usual telephone receivers. Speech is reproduced in the receiver by the motion of columns of air adjacent to the small heated wires. In this case the diameter of the wire is of greater importance, and it is well to consider the relationship between the watts in the wire and the diameter of the wire, the London *Electrician* goes on to say. It is really understood that with very thin wires the great area of radiating surface as compared with the small cross-section allows the heat generated by the current to dissipate very rapidly. This property is made use of in the construction of thermophone receivers. The hot-wire receiver will only respond to the transmitter to which it is connected. When speaking it is necessary to speak close to and into the transmitter mouthpiece for the best transmission. Inductive effects are absent and, there being no diaphragm, there is no inherent distortion. The instrument has the great advantage of responding perfectly to low-spoken tones or whispers, and if the voice is raised there is no clash or confusion of sounds. It is extremely light in weight, from 0.25 to 0.5 oz.—*The Scientific American,* June 12, 1920.

ORDNANCE

THE ERA OF THE EIGHTEEN-INCH GUN.—Although there is not as yet an 18-inch gun afloat in our navy, there is reason to believe that already the adoption of the 18-inch gun is contemplated by the Bureau of Ordnance. If so, we shall probably have a renewal of the old controversy between the advocates of great volume as against great weight of fire, such as more than once has stirred up no little tempest on the calm waters of bureaucratic procedure and found an echo in the outside civilian world.

The contention that the discharge of a large volume of projectiles of moderate weight is more effective than that of a smaller number of much greater weight and power, is as old as the history of the rifled gun. The question was hotly debated when we moved up from the 12-inch to the 14-inch gun, and again when we discarded the 14-inch for the 16-inch gun; and it is certain that, if the tests of the new naval 18-inch gun should be satisfactory, the question will once more be threshed out along the old lines.

If the 18-inch gun should be adopted, it will probably be placed on some of our new 43,000-ton battleships. As designed, they were to carry 12 50-caliber 16-inch guns, which means that on the same displacement and with the same speed, fuel supplies and general accommodations, they will be

able to mount only eight 18-inch guns, particularly if the new pieces are to be of 50-caliber length. Many people will be surprised that a reduction of 50 per cent in the number of guns should be necessary when the caliber is increased only about 12 per cent, but this is because the weights of guns and projectiles increase approximately as the cube of the diameter. This applies not merely to the rifle itself, but it affects also the weight of the mount and the loading mechanism, the total weight of projectiles in the magazines, and so forth.

In favor of an 18-inch gun are the following points: The gun is more accurate; its range and energy are much greater; the bursting charge also is greatly increased, and therefore the destructive effect, when penetration of armor has been effected, is far greater.

The disadvantages are that not only is the number of shells delivered in a single salvo 30 per cent less for the eight-gun battery, but because of the greater weight both of gun and ammunition, the rate of fire is slowed down, so that the total number of projectiles delivered in a given time against the enemy is considerably over 30 per cent less than that delivered from the 12-gun ship.

Now, bearing in mind the common saying aboard ship that it is the shells which hit that count, it can be seen that there is over a 50 per cent better chance of landing on the enemy with a 12-gun *Indiana* than there would be with an eight-gun *Massachusetts*. The 16-inch shell weighs 2100 pounds, and if we aim at the highest velocities and make our 18-inch gun 50 calibers in length, the weight of its projectile will probably be about 3000 pounds, a 50 per cent increase in weight which must necessarily slow down the speed of handling. The only 18-inch gun afloat is the big fellow which the British built for the 32-knot cruiser *Furious*, but subsequently mounted on a monitor and used in the bombardment of Zeebrugge. With a view to extending the life of the gun, the British used a heavy projectile weighing 3600 pounds and having a moderate velocity.

Despatches from Washington state that 18-inch guns are to be used on two of the new battle-cruisers. If so, one turret and a pair of guns would have to be dropped, leaving these ships with six 18-inch guns in two-gun turrets, which would be an arrangement similar to that on the battle-cruisers *Repulse* and *Renown*, which mount six 15-inch guns in three turrets.

If the 18-inch gun is to be adopted because of its superior range, it will be possible to utilize it at the longest ranges only in combination with airplane spotting and to make sure of spotting from a point above the enemy's ships, it is necessary that the attacking ship be accompanied by a fleet of fighting machines, sufficiently powerful to insure absolute superiority in the air.—*The Scientific American*, July 10, 1920.

EROSION OF GUNS.—The opportunity of studying the salient features of a large number of experiments on erosion—instead of following the more usual practice of an intensive study of a small number of experiments—was taken advantage of to some extent during the war, but, according to a paper by Mr. H. E. Wheeler, of Chicago, no new facts were developed. Cracking of the surface of the bore, due to the formation of a hard layer of metal of low ductility, is the most serious form of erosion. The enlargement of these cracks and the consequent roughening of the bore is one of the principal factors determining the life of guns of large caliber. Steel that will resist this penetration must be of such composition as to resist the formation of the solid-solution phase—chromium, etc.—and at the same time must be as little penetrable as possible by the gases. Tests made by the Ordnance Department of the United States Army showed that even after a few rounds there is a noticeable hardening of the surface. The formation follows the driving side of the lands preferentially, and eventually affects the entire land and groove, and even the powder chamber. The formation on the bearing surface of the lands extends much further down

the bore than on any other part of the circumference. Owing to its low ductility, it at once develops a network of fine hair cracks which make a characteristic pattern, the largest cracks being parallel with or perpendicular to the axis of the bore.—*The Engineer*, June 25, 1920.

THE CAPITAL SHIP: A TRIPLE VERDICT.—The methodical way in which the United States and Japan continue to add dreadnought after dreadnought to their respective fleets indicates more convincingly than words could do the confidence which these two Powers retain in the big battleship. On March 3 of this year the *Maryland* was launched at Newport News, Va., and a few days ago the *Mutsu* was put afloat at Yokosuka for the Japanese Navy. The two ships are strikingly similar, as the following details show:

	U. S. S. Maryland	H. I. J. M. S. Mutsu
Length	624 ft. (overall)	661 ft.
Beam	97 ft. 3 in.	95 ft.
Draft, mean	30 ft. 6 in.	30 ft.
Displacement, normal.	32,600 tons	33,800 tons
Speed	21 knots	23½ knots
Main armament	8 16-in. 45-cal.	8 16-in. 45 cal.

The Japanese ship is thus 1200 tons heavier, and has an advantage in speed of 2½ knots. Probably, however, she has less protection than the *Maryland*, which carries 16-inch armor on the belt and 9-inch to 18-inch on the turrets. The *Mutsu's* secondary battery will consist of 5.5 mm. or 6-inch Q. F., as compared with 5-inch guns in the American vessels, while the former is likely to mount a heavier torpedo armament. Generally speaking, in modern ships the size of the beam gives the measure of anti-torpedo protection, in which feature the *Maryland* apparently is superior to her contemporary. But to those who attach value to a good turn of speed the *Mutsu* will appeal as the better ship.

Powerful as these two ships are, they are far from representing the apex of foreign battleship development. For the time being Great Britain is out of the running, and, as it were, living on her capital. But sooner or later—failing the establishment of the League of Nations on a solid basis and its corollary of a limitation of armaments—she will have to resume the burden of naval shipbuilding, and by that time dimensions and cost will probably have risen to a gigantic figure. It is as well that this probability should be recognized now; otherwise there is sure to be an outcry when Parliament, a few years hence, is asked to sanction the building of 50,000-ton battleships, costing anything from eight to ten millions sterling. The monster vessels on which the United States and Japan are working cannot be dismissed as "mythical armadas." Six American ships, constituting the latest class, have been laid down in the past eight months, and two of their number (*South Dakota* and *Indiana*) were seven per cent complete on March 1. This type will displace 43,200 tons normally, 45,000 tons at full load, and mount a battery of 12 16-inch 50-caliber guns. Larger and more expensive still will be the six American battle-cruisers, the first of which, *Saratoga*, was laid down a few weeks ago. Not to be outdone, the Japanese are beginning work this summer on two new battleships, *Amagi* and *Akagi*, reported to displace 53,400 tons at normal draft; and, if precedent counts for anything, the United States will soon produce something bigger still. It is therefore quite misleading to talk of the *Hood* as the "last word" in naval design, as some papers persist in doing. Alike in size, speed, fighting power, and cost that ship will be surpassed by the *U. S. S. Saratoga;* and whereas the *Hood* is the sole representative of her type, the *Saratoga* boasts no less than five sisters.

Those who are not conversant with the technicalities of the subject may well feel puzzled at this wholesale production of ships which certain eminent naval officers in this country have pronounced to be so much scrap iron. But there is really no mystery about it. After a patient and ex-

haustive examination of all the data provided by the war, the shrewdest experts in America and Japan have come to the conclusion that an effective substitute for the capital ship has yet to be devised—in other words, that the large, well-armored, heavily-gunned battleship is not seriously menaced by attack from above or below, and can only be fought on equal terms by a ship of her own type. No one will accuse either America or Japan of ultra-conservatism; both are thoroughly progressive nations, and are always among the first to seize and exploit a promising innovation in the realm of naval science. Consequently, their action in continuing to lay down huge battleships designed to move and fight upon the surface of the sea may carry conviction even in circles where the British Admiralty's recent defence of the capital ship was attributed to the traditional conservatism of Whitehall.

I am assured on good authority that the Japanese naval constructors within the past three years have spent large sums of money on experiments to determine the best method of enabling heavy ships to resist underwater explosion; further, that the result has been to confirm their view that a ship may be made virtually invulnerable to such attack by devoting a not unreasonable percentage of displacement to protective devices, which also assist in minimizing the effects of gunfire. The same conclusion, based either on practical experiment or war data, had previously been reached by the British Admiralty and the United States Navy Department. This means that the technical directors of the three leading naval powers of the world have awarded a certificate of the highest efficiency to the capital ship, and it will take something more than theory to upset this triple verdict.

Apparently there is still an acute divergence of opinion regarding the value of speed. The prevailing view on this side is that very high speed does not balance a deficiency in armament or protection; and, in conformity with this view, the original plans of the *Hood* were modified on the basis of reduced speed and increased protection. In America, on the other hand, they are still prepared to make heavy sacrifices in order to obtain superiority in speed. According to latest report, the battle-cruiser *Saratoga*, which is two knots faster than the *Hood*, will have a belt only five inches thick, compared with 12-inch armor in the British ship. Should this be correct, it will incline naval opinion in this country to assess the actual fighting value of the *Saratoga* at a figure considerably lower than the rank she occupies on paper. The lesson of Jutland, where several ships superior in speed and armament were destroyed by opponents inferior in every quality but that of protection, has sunk deep into naval minds on this side, and armor, once held in very light esteem, is now regarded as second only to gun power.—*The Naval and Military Record,* June 9, 1920.

MISCELLANEOUS

CHARACTER BUILDING IN THE ARMY.—There was no finer result of the World War than the liberation of the spirit of service caused by the call to arms. The war presented a single objective for the creative energies of the entire nation, and in striving to attain this objective the people became a united nation as never before. The national spirit was expressed in a democratic and effective army and navy which maintained American ideals abroad with success and dignity. All of the diversified national forces and capabilities were organized to accomplish a single end, and the war was won.

The people of the United States, having experienced the exhilaration that comes from service in a righteous cause, are now searching for new ways and means of continuing this service in time of peace. They have learned that personal interest and ambition are not so inspiring or absorbing as national interest and service. They have learned to cooperate with one another in new ways and desire to continue to cooperate for the public good. The problem of preserving the lasting lessons of war experience is one of the most pressing problems now before the country.

As far as the army is concerned, this problem may be analyzed by noting the changes that were wrought in army activities by experience. For before the war the army was a numerically small and frequently unrecognized factor of national strength. It always was a symbol of national defense and an embodiment of the spirit of national service; yet it was a tight little army—a thing little observed and apart from the national life except when disorders arose. There was little intercourse and less mutual understanding between soldier and civilian. In fact, many civilians were prone to regard the soldier as an anachronism, as a relic of a bygone age.

With the outbreak of the war, these untoward conditions were suddenly changed. The soldier was dragged from his military isolation and placed in the center of the stage. The nation went enthusiastically to work to create an army that would adequately express the national spirit and power. In the process old misunderstandings have been cleared up. The civilian has caught the spirit of service and discipline of the soldier, while the soldier has grasped the value of the humane and liberalizing elements of civil life.

Inspired by the belief in this opportunity for national service, the army has definitely instituted a system of human development based upon its long practice as a military training institution and its experience during the emergency, and since the armistice, in education, vocational training, citizenshin instruction, healthy recreation and development of a real sense of moral values. This system is conducted according to the high standards and ideals of national service which the army throughout its history has possessed. The system broadens army activities. It intensifies, animates and modernizes military training to agree with the conception derived from the war of the man as a combined soldier and citizen.

In this work the military training is being conducted in such a manner that adequate means for national defense will be always available. The officers are being trained as the leaders of men, and the soldiers are trained as intelligent and capable national defenders who have at all times every incentive and opportunity to become themselves leaders if they can develop the qualities of leadership. The education now given in the army effectively guarantees that soldiers, whose pre-army education has been defective, cannot remain illiterates, and offers to all members of the army a real opportunity to acquire occupational skill which will enable them to leave the service qualified to be self-supporting citizens. Education for illiterates and non-English speaking soldiers is made compulsory and is conducted by officer, soldier and civilian teachers and according to methods devised by expert civilian educational counselors. Occupational training is given under instruction methods developed by expert vocational trainers who have been employed by the army, many of them on leave from the leading educational institutions of the country. Teachers of occupational training are obtained by the employment in the army of well-qualified civilian teachers and by the use of officers and soldiers as instructors who have, by their pre-war experience or their experience during the war, learned the practical details of the occupations in which they instruct. Army education also provides for the army the large number of technical specialists that modern war demands.

The question of leisure time of officers and soldiers also receives careful consideration. The army is a very closely knit community. Officers and soldiers not only work together but live together. The army realizes its obligation to provide means whereby officers and soldiers may be given a moral equivalent for the home environment which civilians possess. It has therefore established clubs and recreation centers in its various posts. camps and stations. It equips libraries, builds theaters, provides professional entertainment for these theaters, and encourages the development of amateur dramatics. Experience during the World War has shown that soldier players can produce dramatic work of high character. Music is

encouraged, and the formation of vocal and instrumental musical organizations is fostered. Athletics, which has always been an important army activity, is given further stimulus, and athletic equipment and instruction is adequately provided. Exchange or cooperative stores run by the army for the benefit of the army have been maintained for a great number of years. These, conducted according to modern business methods, will continue to serve officers and soldiers, their profits being used for promoting recreational activities.

The World War emphasized the fact that strength of character in the nation and strength of character in the soldiers of the nation are the final decisive elements upon which victory rests. Every activity of the soldier's life has a definite effect in strengthening or weakening character. Hence, military training and duties, general and vocational education, recreation and all functions of army life are coordinate with the definite purpose of developing self-control, self-respect, realization of the obligation of service and moral thoughtfulness in all officers and soldiers. This ideal of service is emphasized in every activity of the army. Recreation is conceived in the spirit of fair play, athletics emphasize fair play, clean sport, and teach officers and soldiers not only to be successful winners but to be good losers and to combat the ever present temptation to make "anything to win" the standard.

Religion as an essential to life is recognized, and provision is made for the religious needs of the army personnel. It is believed that each citizen of our nation is free to establish his relationship to God according to the dictates of his conscience, and each officer and soldier is given an opportunity to follow the faith of his choice. Respect and encouragement for religion are held as important obligations of an officer's position of leadersip.

The army believes that the soundest morality and the highest character are those developed by the individual himself in response to his own incentives. Therefore soldiers have been urged to form clubs or associations with the explicit purpose of encouraging initiative, self-reliance, "teamplay," a broadminded tolerance, an intelligent patriotism, and the desire to serve one's group, one's neighborhood and one's country. These clubs are looked to for the development of a fine spirit of service on the part of their members. In these clubs the soldier learns the practical details of community life and its consequent community obligations. Upon the soldier as a club member rests a portion of the responsibility for the success of the club. Upon the citizen who returns to civil life from the army will rest his share of the responsibility for his community.

This broad conception which the United States Army now has of its full mission to the country and the diverse activities it has entered upon make it most vitally necessary that the army, if it is to succeed in this mission, have the greatest amount of cooperation from the communities near the posts, camps and stations of the army, from all of the finest and best organizations of our social life and from the common enthusiasm and spirit of the whole nation. The army has set up specific machinery to insure the fullest cooperation between its officers and soldiers and the communities in which officers and soldiers are located. It is urging communities and the people of the country to consider the army as a vital and natural part of the social organism of the nation and not to consider the armed forces as separate and distinct from the rest of American life, but as inevitably and permanently interwoven with the whole social fabric.

In its purpose to express essentially American ideals and to develop American men according to this program the army feels that it may properly ask and will undoubtedly receive the support of all good Americans and of all organized bodies of American life that stand for the progressive betterment of our country.—*The Infantry Journal*, July, 1920.

THE SCIENTIFIC VALUE OF SPEED CONTESTS.—In all great sporting contests in which high speed is the deciding factor, many people, in whom the critical faculty is developed at the expense of others equally valuable, make themselves audible in protest against the sacrifice of strength and durability which is necessary in producing a first-class racing machine, be it airplane, yacht or automobile. "What is the sense," they ask, "of building a contraption which, if it should be so fortunate as to hold together for one supreme effort, has no further use in the broad field of sport and pleasure?"

An off-hand answer to this question would be to remind these gentlemen that sport is sport; that the craving for high speed is a protest against the natural inertia of things; and that, if a man does not possess in his veins the good, red blood to which speed as an element of sport appeals, it is more his misfortune than his fault, and he is to be pitied rather than blamed. But, as a matter of fact, the ardent pursuit of speed in racing machines has reacted most favorably upon the mechanical arts. The race course is a very practical, man-sized kind of laboratory, where the products of the labor of the designer at his drafting board are given a gruelling test, during which the one weak link in the chain, if there be such, is certain to be disclosed. The great value of the construction and competition of racing machines is that we gain in knowledge of the dynamic as compared with the static stresses. Static stresses can be determined with great accuracy, and the testing machine gives us equal accuracy in determining the strength of materials; but in driving an automobile at a racing speed, and even more in smashing one's way with an over-sparred and lightly-constructed yacht against short, snappy seas, there are dynamic stresses developed, the exact strength and effect of which no man can foretell through the medium of theoretical calculations.

Moreover, racing has greatly stimulated the quest for materials that are light in proportion to their weight; and there can be no doubt that for the many wonderful alloys which are available in the constructive arts to-day we are beholden, not a little, to the craze for speed, with its demand for a maximum of strength with a minimum of weight. To think of the racing car is to think of aluminum, vanadium steel, and last, the wonderful molybdenum steel; and a restrospective survey of the America's Cup races calls to mind the hollow steel boom of *Valkyrie III*, the Tobin bronze and aluminum hull of *Defender*, the light but strong hollow wooden spars culminating in the great hollow mast of *Shamrock IV*, and the tapered, hollow aviation spar which forms the topmast of *Vanitie*, to say nothing of the aluminum gaff carried by *Resolute*. A test case as to the industrial value of yacht construction is the three-ply mahogany shell of *Shamrock's* hull, which proved so tough and strong and water-tight that its designer built Government ships, during the war, of a thousand tons capacity, on this principle.—*The Scientific American*, July 10, 1920.

SIGNALLING BY INVISIBLE RAYS.—Remarkable feats in signalling by radiations outside the visible spectrum, both infra-red and ultraviolet, were accomplished during the war and, it must be added, still more strange things were attempted. It was found possible, for instance, to detect the presence of a living warm body, lying outside a trench in the dark, by the heat rays coming from it. But it was hardly possible, though repeatedly suggested, to discover the approach of a steamer or submarine, in a fog, by the thermal radiations from the smoke stack, since water vapor is opaque to infra-red radiations. The experiments on secret signalling were not initiated during the war. Books on the subject were published in 1913, by Ruhmer in Germany and by Miessner in the United States. Since selenium was the most sensitive photoelectric substance then known, the first war experiments were conducted with selenium. But a search for photoelectric substances was made, notably by Case and by Coblentz and others in the Bureau of Standards, and several sulphides were found promising. Some

crystals of molybdenite, molybdenum sulphide, in particular proved up to 200 times as sensitive to heat rays as a gold leaf radiometer, an instrument of the bolometer type. Gold and platinum, blackened on the one side with soot, absorb all the incident radiations and are hence not suitable for the selective absorption of heat rays. The man in front of a trench is difficult to detect when he wears a heavy coat and covers his face, and a boat is not easily picked out from a shore background.

In the radiophonic signalling of the Bureau of Standards, so far as described by W. W. Coblentz last year before the American Physical Society (the full paper is not yet available), a pulsating electric current is produced by interposing a rotating sector-disc between the source of radiation and the receiver. The receiver consists of a crystal of molybdenite, a battery of dry cells, of about 50 volts, connected directly to the input terminals of a three-stage amplifier and a telephone; a concave mirror, silver on glass, of 16 cm. diameter and 50 cm. focal length, concentrates the radiations on the receiver. In the simpler field apparatus, the crystal mirror, disc and battery of six cells are mounted on a camera tripod.

In the experiments conducted at Washington, the transmitting and receiving stations were situated on the roofs of two houses, separated by three miles of houses and dusty streets. When the radiation source was a 300-candle tungsten lamp mounted in a searchlight reflector, the transmission was very good at the full distance mentioned. With an automobile headlight of 20 candles in a metal reflector the signals were not always audible; sighted on a street lamp (80 candles) the apparatus still responded at a distance of half a mile, but the interposition of a glass screen and the exclusive use of the infra-red rays made the signals uncertain.

The full moon proved an excellent source of radiation; the intensity of the moonlight is estimated at 3×10^{-7} gramme-calorie per second. Since the sector disc used cut off about half of the light and reduced the time of exposure to about 1/500 second, the sector wheel radiophone could not be very efficient, and attempts were made to change the pitch in the telephone note, apparently on the heterodyne reception principle. It was observed that the high resistance then wanted in series with the crystal weakened the sounds, but when several crystal-receivers were connected in series to make up the resistance, better results were obtained. Considerable success was realized with potassium-hydride photoelectric cells of the gas-ionic type; but particulars were not communicated.

Professor R. W. Wood, of Baltimore, who came over to France, devised several other ingenious devices which he himself built up out of very primitive apparatus. When he demonstrated their use, so far as desirable, before the Physical Society of London, he particularly spoke of a small lamp arranged in telescope fashion so as to give a very narrow, almost invisible, beam of light. To secure further secrecy he used a red light filter for day service and an ultraviolet filter for night service, the observer being correspondingly provided with a red screen (which shut out the daylight but transmitted the red beam) or with a fluorescent screen.

Another device was Professor Wood's lamp for naval convoy, radiating in all directions. This was a mercury lamp provided with a glass chimney permeable only to rays of λ 3660; these are invisible, but they make the retina and lens of the eye fluoresce so that an observer at close quarters sees a haze, the so-called "lavender fog," filling his field of view; the rays could only be picked up by a receiver comprising a fluorescent screen. This instrument had a range of four miles (that previously described had a range of six miles) that by its aid ships were kept together without showing any light.

We need hardly say that similar devices were worked out in this country. It is to be hoped that the researches are proceeding, though they may remain for the present locked up in official archives. There is, however, little need for secret signalling in normal times. But astronomers, meteorologists and other scientists might find such instruments useful, and the thermo-

ionic valve, which forms part of some of these devices, has sufficiently established the startling technical possibilities of observations apparently of purely theoretical interest.—*Engineering,* June 11, 1920.

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NOTES ON INTERNATIONAL AFFAIRS

FROM JUNE 10 TO JULY 10

PREPARED BY

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WORK OF THE SPA CONFERENCE

PRELIMINARY MEETING AT BOULOGNE.—At a preliminary conference of Allied premiers held at Boulogne on June 22 a note was approved and despatched to Germany concerning the reduction of her war materials and limitation of her army to 100,000 men. It was also decided that Greece should be authorized to undertake military operations against the Turkish Nationalist forces in Asia Minor, and that trade parleys with Russia should continue on the condition that there should be no question of recognizing the Soviet Government.

BRUSSELS CONFERENCE FIXES INDEMNITY.—Meeting at Brussels on July 2, as a preliminary to the Spa Conference, Allied diplomats agreed definitely that the total sum to be demanded of Germany should be 6,000,000,000 pounds sterling (or 30,000,000,000 dollars at normal exchange), to be paid at the rate of 150,000,000 pounds a year for the first five years, and 250,000,000 pounds a year thereafter, with accrued interest.

The difficult problem of settling upon the division of the German reparation money remained undecided. According to the plan previously approved, France would receive 52 per cent, England 22 per cent, Belgium 8 per cent. and Serbia 5 per cent, leaving 13 per cent for Italy, Portugal and Japan. Italy, however, presented claims for 20 per cent which she suggested should be apportioned without depriving Belgium of any part of her share. It was finally decided that the division might properly be left until an agreement was reached with Germany as to what she should pay.

GERMAN APPEAL.—A 50,000 word memorandum presented by Germany made no reference to the amount Germany would be able to pay, but requested the following concessions, as essential to Germany's economic recovery:

(a) Equality of Germany on "the most favored nation" basis in trade with her former enemies.

(b) No military reprisal measures without warning.

(c) Restoration to the German Government of control over all German waterways and means of transportation.

(d) Right to collect import duties in gold.

(e) Reduction of cost of occupation forces, below the cost of 3,000,000,000 marks for last year.

(f) Allotment of merchant tonnage up to 13,000,000 tons annually.

(g) Proceeds of German property liquidated abroad.

Against these claims, it was pointed out that the Allies might urge in the first place the fact that Germany is the only one of the warring European powers that did not contract a heavy foreign debt in the course of the war.

RESULTS OF THE SPA CONFERENCE.—The meeting of German and Allied diplomats at Spa, in Belgium, opened on July 5, the program for discussion including disarmament, prosecution of war criminals, fulfilment of coal agreements, the Danzig question, and reparation.

Discussion of the reduction of the German army brought out the fact that of over 6,000,000 German rifles at the close of the war 2,000,000 remained unaccounted for, and that 1,000,000 men were still under arms. Germany pleaded that the government could not maintain peace, in view of the disturbed condition of the country, without an armed force of at least 200,000. Under Allied pressure, however, a protocol was signed on July 9. by which Germany agreed to complete the required reduction in six months' time.

In the matter of prosecution of war criminals, Germany requested further evidence and more time.

In general, the decision to include German diplomats at the Spa and later conferences represented a victory for British policy over that of France, and a virtual recognition of the fact that the terms of the Versailles Treaty are still a matter for debate. At the first contact with German diplomats the Allied powers maintained a united front.

LEAGUE OF NATIONS

REPUBLICAN PLANK IN LEAGUE OF NATIONS.—The Republican Party stands for agreement among the nations to preserve the peace of the world. We believe that such an international association must be based upon international justice and must provide methods which shall maintain the rule of public right by development of law and the decision of impartial courts and which shall secure instant and general international conference whenever peace shall be threatened by political action, so that the nations pledged to do and insist upon what is just and fair may exercise their influence and power for the prevention of war.

We believe that all this can be done without the compromise of national independence, without depriving the people of the United States in advance of the right to determine for themselves what is just and fair when the occasion arises and without involving them as participants and not as peacemakers in a multitude of quarrels, the merits of which they are unable to judge.

The covenant signed by the President at Paris failed signally to accomplish this purpose and contained stipulations not only intolerable for an independent people, but certain to produce the injustice, hostility and controversy among nations which it proposed to prevent.

That covenant repudiated to a degree wholly unnecessary and unjustifiable the time-honored policy in favor of peace declared by Washington and Jefferson and Monroe and pursued by all American administrators for more than a century, and it ignored the universal sentiments of America for generations past in favor of international law and arbitration, and it rested the hope of the future upon mere expediency and negotiation.

The unfortunate insistence of the President upon having his own way without any change and without any regard to the opinion of the majority of the Senate, which shares with him in the treaty-making power, and the President's demand that the treaty should be ratified without any modification, created a situation in which Senators were required to vote upon their consciences and their oaths according to their judgment upon the treaty as it was presented or submit to the commands of a dictator in a matter where the authority under the Constitution was theirs and not his.

The Senators performed their duty faithfully. We approve their conduct and honor, their courage and fidelity and we pledge the coming Republican Administration to such agreement with the other nations of the world as shall meet the full duty of America to civilization and humanity in accordance with American ideals and without surrendering the right of the American people to exercise its judgment and its power in favor of justice and peace.

DEMOCRATIC LEAGUE PLANK.—San Francisco, July 1.—The vital section of the Democratic League of Nations plank as adopted by the Committee on Resolutions with the final phrase added by the amendment of Senator Walsh of Massachusetts reads:

"We indorse the President's view of our international obligations and commend Democrats in Congress for voting against reservations designed to cut to pieces the vital provisions of the Versailles treaty and against resolutions for a separate peace which would disgrace the nation. We advocate prompt ratification of the treaty without reservations which would impair its essential integrity, but we do not oppose reservations which would make more clear or specific our obligations to the associated nations."

LEAGUE DEFERS ACTION ON PERSIAN APPEAL.—On June 16, the League Council in session in London notified Persia that action would be deferred regarding Russian occupation of the Persian Port of Enzeli on the Caspian Sea, pending the result of direct negotiations between Persia and the Soviets. In a note to Persia announced on June 15, the Soviet Foreign Minister assured Persia that the Soviet Government had "no designs against Persian independence," and that Russian troops would be withdrawn from Enzeli as soon as "Persian independence is guaranteed and she is no longer under foreign influence."

REPATRIATION OF PRISONERS.—In a report to the League Council at London, Dr. Nansen stated that there were still about 250,000 former prisoners of war in Russia, and as many more in Germany and neighboring countries. Exchange was going on through Esthonia and Finland, and he hoped to send home 60,000 Russians and an equal number of Germans before winter.

FINANCIAL CONFERENCE ON JULY 23.—In a letter to the Supreme Council, M. Leon Bourgeois, acting for the Council of the League of Nations, stated that the League financial conference would be held at Brussels on July 23. M. Bourgeois urged the necessity of determining definitely at Spa the obligations of Germany and the general economic situation of the former central powers. He also pointed out the necessity of inviting German delegates to the Brussels meeting.

WORK ON WORLD COURT.—The first session of the commission for organizing a permanent court of international justice was held at The

Hague on June 16. It was decided that the court should be permanently located at The Hague. It was also agreed that in at least five types of cases, involving interpretation of treaties, infractions of international law, or interpretation of court decisions, resort to the court should be compulsory. On July 5 it was decided that the Root-Phillimore plan for the selection of judges should be used. This plan provides adequate representation for small states.

TURKEY AND THE NEAR EAST

MAP OF ASIA MINOR SHOWING THE MAIN RESULTS OF THE TURKISH PEACE TREATY. THE SOUTHWESTERN BOUNDARY OF ARMENIA IS GIVEN HERE TENTATIVELY ALONG THE GENERAL LINES WHICH PRESIDENT WILSON IS EXPECTED TO FOLLOW AS ARBITRATOR. ALL THAT REMAINS OF TURKEY IN EUROPE IS THE LITTLE CORNER FROM CONSTANTINOPLE TO CHATALJA.—*July N. Y. Times Current History.*

GREEK OFFENSIVE AGAINST TURK NATIONALISTS.—During the month of June Premier Venizelos of Greece secured the approval of the Supreme Council for a Greek campaign in Western Asia Minor against the Turkish insurgents under Kermal Pasha. With the cooperation of British naval forces, the campaign began about June 21, from both ends of the railroad from Smyrna to Panderma in the Sea of Marmora. It was ended July 2, with the junction of the two forces and complete occupation of the railway. On July 8, it was reported that the city of Brussa, 57 miles southeast of Constantinople, was held by Greek forces. Mudania, on the Sea of Marmora, was shelled and occupied by British naval forces on July 5.

TREATY NEGOTIATIONS POSTPONED.—On June 26, the Turkish peace delegation presented a memorandum explaining their objections to the Peace Treaty in its present form, and on July 1, the Turkish Grand Vizier, head of

the delegation, returned to Constantinople. The Supreme Council decided later at Spa that the treaty should be revised in details by experts to accord with the legitimate objections of the Turks.

POWERS OF STRAITS COMMISSION.—Washington, June 16 (Associated Press).—Limited internationalization of the Port of Constantinople and its inclusion within the "zone of the straits" is provided for in the provisional terms of the Turkish treaty. This is disclosed by an official summary received here to-day of the jurisdiction provided for in the Inter-allied Commission of Control.

With its own flag, budget and separate organization, the commission will have authority over a territory considerably greater than some of the smaller nations of Europe. Made almost sovereign in itself, the commission is to be practically independent of the League of Nations, as stipulation is expressly made that should it find liberty of passage of the straits interfered with, it shall take such measures as may be deemed necessary to preserve the freedom of the straits.

The zone includes not only the Bosporus, Sea of Marmora and the Dardanelles, but also three miles off shore from the mouth of the Dardanelles and the Bosporus and the Aegean Islands of Samothrace, Imbros, Lemnos, Tenedos and Lesbos. A land zone also is provided, extending from ten to seventeen miles northwest of the Sea of Marmora and eight to twenty-eight miles southeast of it.

Its northwestern limit is partly common with the new Greek frontier, 52 miles west of the Bosporus, on the Black Sea; its eastern limit is 40 miles east of the mouth of the Bosporus, and its southwestern limit is partly common with the district of Smyrna, 55 miles southeast of the entrance to the Dardanelles. The zone also includes an area on the western side of the Gallipoli Peninsula which Turkey cedes to England, France and Italy for war memorials and cemeteries.

Regulations laid down for enforcement by the Inter-Allied Commission provide that:

No belligerent warships may remain within ports of the zone longer than twenty-four hours or take on food, stores or recruits.

The Dardanelles, Sea of Marmora and the Bosporus are to be open in peace and war to every vessel of commerce and war.

The straits are not subject to blockade.

No belligerent right to be exercised and no act of hostility committed within the zone, except upon special authorization of the League of Nations.

All military works and fortifications to be demolished, and no roads or railroads to be constructed within the zone for movement of mobile batteries.

Greece and Turkey are prohibited from constructing any new wireless stations within the zone; all present ones to be taken over by the Allied powers.

These regulations are to be enforced chiefly with naval forces and a force of special police recruited within the zone and commanded by foreign officers, as well as such military and naval air forces and guardships of their own as Great Britain, France and Italy may deem necessary.

In addition to the general laws pertaining to the administration of the straits, the commission is further charged with execution of any works considered necessary for the improvement of the channels and the approaches to harbors, the lighting and buoying of channels, control of pilotage, towage, anchorage and all matters relating to wrecks, salvage and lighterage.

Maintenance of the ports of Constantinople and Haida Pasha as ports of international concern, where the citizens, goods and flags of all countries

belonging to the League of Nations shall enjoy complete freedom, is also placed within the control of the commission, which shall provide at the two ports free zones for the erection and use of warehouses.—*N. Y. Times,* June 17.

RUSSIA AND POLAND

POLES RETREAT BEFORE RED OFFENSIVE.—During the latter part of June and the month of July Soviet forces in great strength developed a vigorous offensive along the whole Polish battle line, concentrating their efforts on the northern front. The fall of the fortress of Rovno, on the Volhynia front east of Lutsk, was announced on July 7.

Falling back before the Russian advance, Poland issued a call for all able-bodied men and concentrated government administration in a military triumvirate. Defending Poland's war with the Soviets, the Polish Minister to the United States issued on July 9 a statement in part as follows:

The present difficult situation of the Polish Army is widely regarded here as the natural result of what is considered a short-sighted move in attacking Russia. It has been pointed out again and again that Poland, in the Ukraine offensive, was attacking national Russia rather than the Bolsheviki, thus placing the Soviet Government in the rôle of national defender against a foreign foe. It has been foreseen here for some time that the support thus brought to the Red leaders of Russia for the needs of the moment would be sufficient to crush the Polish efforts in that direction. Poland, it is pointed out, has united both Bolsheviki and loyal Russians against her.

The statement issued by Count Lubowurski says:

"The war which Poland is carrying on is not one of conquest, but exclusively one of defense. The Bolsheviki invaded Poland at the moment of its liberation, and we were forced to take up arms in our defense. We have no intention of going to Moscow, nor interfering in Russian affairs. We have not even passed the frontiers of Poland of 1772. We have not even asked for the territory which belonged to us before 1772. We have only wanted to protect those regions peopled by Polish subjects, to liberate them from the oppression of Bolshevism and to create around us friendly nations who will stand with us against the barbarism of the East.

"The propositions of peace of the Soviet Russia were not sincere. We knew they were preparing a great attack, and we wanted to avert it by a drive on their points of concentration, but the young Ukrainian Republic was not able to organize in such a short time an army sufficiently large to withstand the avalanche of Bolshevism.

WRANGEL ADVANCES IN SOUTH RUSSIA.—In the Crimea, the Anti-Soviet forces under General Wrangel, reorganized from General Denikin's defeated army, again advanced northward, meeting slight opposition on account of the Soviet concentration against Poland.

The British naval occupation forces at the Black Sea port of Batum have blown up the fortifications, with the view of evacuating the city before July 18 and leaving it an open port under control of the Georgian Republic.

TRADE PARLEYS TO CONTINUE.—At the Boulogne Conference on June 22 it was decided that trade negotiations with Russia in London should continue, on the understanding that there should be no question of recognizing the Soviets. This decision represented a compromise of the divergent policies of Great Britain and France, Great Britain desiring to secure

various political aims by holding out the prospect of trade, France opposing any action which might enable the Soviet Government to establish itself and repudiate the debts of the old régime.

On June 30 M. Krassin, the Russian trade delegate, left London for Moscow, ostensibly to consult his home government. This was regarded at the time as a rupture of negotiations, though later rumors appeared to the effect that he would be succeeded at London by M. Tchitcherin, Soviet Foreign Minister.

UNITED STATES REMOVES TRADE RESTRICTIONS.—On July 7 the United States Department of State issued the following announcement of the removal of restrictions on Russian trade:

"The restrictions which have heretofore stood in the way of trade and communication with Soviet Russia were to-day removed by action of the Department of State. Such of these restrictions, however, as pertain to the shipment of materials susceptible of immediate use for war purposes will, for the present at least, be maintained.

"Political recognition, resent or future, of any Russian authority exercising or claiming to exercise governmental functions, is neither granted nor implied by this action. It should be emphasized, moreover, that individuals or corporations availing themselves of the present opportunity to trade with Russia will do so on their own responsibility and at their own risk. The assistance which the United States can normally extend to its citizens who engage in trade or travel in some foreign country whose Government is recognized by the United States cannot be looked for in the present case, since there is no official or representative Russian authority with which this government can maintain those relations usually subsisting between nations.

"The action which the United States is now taking in nowise constitutes a recognition of the validity of industrial or commercial commissions granted by any existing Russian authority. American citizens availing themselves of the present relaxation of restrictions are warned against the risks incident to the acceptance of commodities or other values, the title to which may later be brought into question."

GERMANY

CABINET FROM MIDDLE PARTIES.—After difficulties and delays, a ministry was finally organized in Germany during the last week of June, under the chancellorship of Konstantin Fehrenbach, former President of the Reichstag. The Cabinet has the support of the "Middle" parties—Centrists, Nationalists, and Peoples Parties—with the "benevolent neutrality" of the majority Socialists. According to figures of June 15, the composition of the Reichstag is as follows:

Parties	Deputies	Popular vote
Majority Socialists	110	5,531,137
Independent Socialists	80	4,809,862
Centrists	67	3,500,800
German Nationalists	65	3,638,851
German People's Party	61	3,456,131
Democrats	45	2,152,509
Christian Federalists	21	1,254,963
Communists (Spartacists)	2	438,190
Bavarian Peasants' Party	4	......
Guelphists	5	318,104

It will be seen that out of a total of over 25,000,000 votes, only about 5,000,000 were cast for candidates of the radical parties, the Independent Socialists and Communists.

The Fehrenbach Cabinet is made up as follows, Ministers Fehrenbach, Simons, and Wirth constituting the German delegation at Spa:

Chancellor—Konstantin Fehrenbach,
Minister of Foreign Affairs—Dr. Walter Simons.
Minister of Finance—Dr. Wirth.
Minister of the Interior—Herr Koch.
Minister of Defense—Herr Gessler.
Minister of Transport—General Groener.
Minister of Food—Andres Hermes.
Minister of Posts and Telegraphs—Johann Giesberts.
Minister of Economics—Herr Scholz.
Minister of the Treasury—Herr von Raumer.

—*N. Y. Times.*

AUSTRIA AND HUNGARY

BOYCOTT OF HUNGARY.—The International Federation of Trades Unions from its headquarters at Amsterdam issued on June 3 a summons for a boycott of Hungary in retaliation for the alleged persecution of labor by the Hungarian "White Terror." The boycott called for a complete stoppage of traffic and communication with Hungary, to be executed by the workers of Austria, Czechoslovakia, and Jugoslavia, and to begin on June 20.

Following the putting into effect of the boycott Hungary endeavored to retaliate by refusing to export coal and food supplies to Austria.

AUSTRIAN CABINET DIFFICULTIES.—The Renner Cabinet in Austria resigned on June 11. During the remainder of June President Séitz held conferences with leaders of the Socialist and Social Christian parties, in a vain effort to set up a new ministry. Both parties coveted the post of Minister of the Interior, because of its value in the impending elections.

ITALY

ALBANIA RISES AGAINST ITALY.—After the conclusion of the World War, Italian forces remained in occupation of Albania, pending settlement of the Adriatic question in which the disposition of Albania was involved. In opposition to the Supreme Council's plan of January 20, 1920, which virtually divided Albania between Italy, Serbia, and Greece, President Wilson came out strongly for Albanian independence. Encouraged by the American atitude, the Albanians organized a provisional government, held a national assembly at Lushnja, January 28, 1920, and planned armed conflict with the Italian forces.

In June Italy began withdrawing troops to the Albanian seaports, and of these she finally retained only Avlona, under the protection of warships. On June 29 came reports of the capture of Avlona by the Albanians, but this was later denied.

GIOLITTI RETURNS TO POWER.—In June the Nitti Government fell for the third and last time. Former Premier Giolitti, suspected of pro-German leanings prior to Italy's entry into the war, came back into power. The Giolitti Cabinet, as announced on June 15, consists of prominent leaders of the Liberal, Catholic, and Radical parties. Admiral Sechi, one of the foremost naval experts, holds the naval portfolio, and Count Sforza that of foreign affairs.

In the Italian Chamber of Deputies the Socialists hold 156 seats, Catholics 101, Liberals 161, the remainder of the 518 seats being occupied by representatives of various small factions. Giolitti's power lies in his continued control of 60 of the 69 provincial prefects who supervise Italian elections, these being hold-overs from his long period of rule before the war.

IRELAND

RIOTS IN LONDONDERRY.—During riots in Londonderry, June 18, 19, and later, between Sinn Feiners and Unionists, five were killed, ten severely wounded, and many others injured. Incendiarism and food stoppage added to the seriousness of the situation in the city, military forces having difficulty in reestablishing order between the hostile factions.

SINN FEIN ASSUMES CONTROL.—According to reports from Ireland, the newly organized Sinn Fein courts are rapidly superseding the crown tribunals, their decrees receiving popular sanction. Sinn Feiners are also enforcing regulations regarding the liquor traffic. Transportation in Ireland is in serious difficulties owing to the refusal of railroad workers to handle trains carrying government troops.

MEXICO

VILLA OFFERS TERMS.—Early in July a representative of the Obregon Government secured from the insurgent leader Francisco Villa an armistice agreement until July 15 and a statement of the conditions upon which he would cease his activities. These include his appointment as a general in the Mexican army, with a force of men to maintain order in certain districts of Chihuahua. Failing agreement to his terms, Villa threatens renewal of brigandage on a large scale.

HIGH COMMISSIONER TO UNITED STATES.—Senor Fernando Calderon arrived in Washington on June 28 as High Commissioner from Mexico with the rank of ambassador. Through his efforts it is believed that friendly and satisfactory relations may be established between the two countries, and the way paved for recognition. Congressional elections in Mexico are set for August 21, and Presidential elections for September 5.

OIL COMMISSION.—It is stated that the Mexican Secretary of Commerce and Labor, General Trevino, will appoint a commission of prominent Mexicans to study the oil question, and will invite the participation of

American representatives. Representatives of American oil interests now in Mexico are not favored for this purpose, because committed to a policy of American intervention.

FAR EAST

JAPAN OCCUPIES SAGHALIEN PROVINCE.—Pending reparation for the killing of Japanese troops and civilians at Nikolaievsk, Japan has taken military possession of the upper part of the island of Saghalien and the opposite coast on the main land. The government on July 3 announced its intention to withdraw its forces from other parts of Siberia, especially from the interior.

Washington, July 6.—Information received here is that the limits of the new Siberian Republic, which already has been recognized by the Soviet Government, probably will include the three Continental provinces of Trans-Bakailia, Amur and the maritime province which includes Vladivostok. These limits, however, remain to be defined by a boundary treaty.

Relations between the Japanese Government and the new Republic, it is said, will depend entirely upon the action of the Siberians themselves and the decision on their part to assume or repudiate responsibility for the massacre at Nikolaievsk.

Advices received here to-day from Japan say the anti-Bolshevist population has welcomed the Japanese forces which have taken military possession of the upper part of Saghalien and the opposite coast on the mainland as a result of the massacre. On the other hand, an active propaganda against the Japanese is being carried on by the sympathizers with the Soviet Government.

It is stated in well informed quarters here that the Japanese troops will make no hostile move against the new Republic unless attacked. At last advice exchanges were in progress between the military leaders on both sides with the design of arranging temporary boundary lines to separate the two nationalities and prevent hostile collisions.

FAR EASTERN REPUBLIC.—At the head of the recently organized Far Eastern Republic, with its seat at Verkni—Udinsk in Trans-Baikalia, is a former Chicago lawyer, A. S. Tobelson, now known as Krasnotchekoff. Tobelson came to Chicago from Russia in 1910, studied law, practiced in labor cases, and in June of 1917 went to Vladivostok, it is said at the invitation of his friend Leon Trotzsky. Here he became head of the Far Eastern Soviet.

ANGLO-JAPANESE TREATY RENEWAL.—Tokio news despatches of early July announced the intention of British and Japanese diplomats to revise the Anglo-Japanese Alliance in conformity with the League of Nations covenant, and to have it ready for signature before the Prince of Wales visits Japan next spring.

Baron Okuma is reported as advocating an alliance in the following terms:

"Without the alliance." he asked, "what about the future of India, and that of China and that of Siberia? The fact is indisputable that for all the success the British Government has attained so far in the administration of India, there are many malcontents in that country. The facts should be particularly noted that the majority of the inhabitants of Northern India are Mohammedans, who are as militaristic as they are religious. Since the

fall of the Turkish Empire there has been increasing unrest among them. To make the situation worse, the Bolsheviki are now very active on the borders of Turkestan and Afghanistan.

"At such a critical period as this nothing could have a worse influence on them than an impression that the Anglo-Japanese alliance is no more and that the Jaapnese would not interfere whatever might happen in India.

"The same theory may be applied to Japan as regards China and Siberia.

"Because of the Monroe Doctrine, the United States may be unable actually to participate in the alliance to be concluded between Great Britain and Japan; but if such participation should be made possible or should be desired by the American people, America would surely be welcomed into the group so as to form a triple alliance and thus maintain the peace of the Orient with greater efficiency."—*N. Y. Times,* July 2.

FOREIGNERS THREATENED AT PEKING.—On July 10 Generals Wu Pei Fui and Tsao Kun were reported to be advancing upon Peking along the Peking-Hankow railroad and threatening bombardment of the city, in spite of the warning of foreign diplomats against such an attack. The advance of the Chinese generals is against the dictatorship assumed by the Chinese leader Tuan Chi Jui.

The International forces at Peking number about 1400, the largest contingent consisting of American marines. About 3300 troops are available at Tien-tsin.

REVIEW OF BOOKS
ON
SUBJECTS OF PROFESSIONAL INTEREST

"The Maintenance of Peace." By S. C. Vestal, Lieutenant Colonel, Coast Artillery Corps, U. S. Army. (Published by G. P. Putnam Sons, New York.)

The secondary title of the book, "The Foundations of Domestic and International Peace as Deduced from the Study of the History of Nations," if for "Foundations" we substitute "Principles," more nearly indicates the scope of the work. The first few chapters are devoted to a discussion of the principles involved in the maintenance of domestic peace, and to showing how these principles have operated in Latin-America and in the United States. The remaining chapters are taken up with the major subject of International Peace. The ways of checking or controlling the tendency to conflict between nations are shown to be by world federation; by single nation domination; or by mutual guarantees of territorial integrity and independence, that is, treaties of alliance for maintaining the balance of power. All of these are fully discussed.

A Large part of the book is devoted to the history of ancient and modern wars, and the effect on the Balance of Power. The author is convinced that the maintenance of the Balance of Power is the only way by which the tyranny of a single nation may be avoided, and that the end of wars will come only by the efficient and immediate application of this principle, and that permanent international peace will exist only when the aggressor nation is sure to encounter overwhelming force, as would an aggressor state of the United States.

Arbitration as a panacea for war is fully discussed, and it is very clearly brought out that the problems of nations are of two general classes—political and legal. Legal problems may well be referred to an International Court of Arbitration, but political problems, which are by far the most numerous and vital, can only be settled by the people themselves, either by the ballot or by the bullet. In international politics, material strength, not morals, decides political questions, and the great problem of a world federation is to find some way by which international political questions may be settled by the numerical strength of the voters.

The book shows extensive study and thought on the part of the author, and his statements of facts taken from the history of the nations of the world, and his deductions of lessons to be drawn therefrom are clear, concise and entirely logical. The author concludes that universal disarmament is impracticable, as for domestic tranquillity some preparedness for

war is essential, and even if there were only one nation in the world the problem of domestic peace would still exist. No government can continue to exist unless it has the force to carry out its laws, and there is for every nation an irreducible minimum of preparedness that must be accepted. Universal disarmament would mean universal weakness for each subscribing nation as regards its own domestic force. Domestic peace can be guaranteed only by force in the hands of the majority. Disarmament makes civil war inevitable. International peace depends upon the known readiness of the nations of the world to aid each other in case of attack. The author shows how this end can be obtained.

In view of the recent general discussion of the principles of the League of Nations and the vital nature of the question of the advisability of the United States joining the League, this book should prove of special interest. It is well worth the reading and the careful thought of all students of governments and history, and should be particularly instructive to those in the military or naval service.

W. G. D.

"Hot Bulb Oil Engines and Suitable Vessels." By Walter Pollock, M. I. N. A., M. I. Mar. E., M. I. Mech. E., M. I. M. $10.00. (Published by D. Van Nostrand Company.)

The objects of this book, as stated in Chapter I, are: "(1) To popularize the engine, to explain what it has done and what it is capable of doing; (2) to enable those interested to appreciate the advantages and disadvantages of the various designs; (3) to facilitate the study and add to the general knowledge of this form of prime mover and its application to various types."

The author presents comparisons between the hot bulb oil engine (commonly and, according to the author, erroneously known as the Semi-Diesel) and all other accepted methods of propulsion for vessels of small and medium tonnage. A chapter on the different makes of hot bulb engines describes, without showing all detailed particulars, the characteristic features of some thirty-six commercial engines of this type, suitable for marine propulsion. The volume includes: A wealth of information, valuable to owner and operator, on design, parts, materials, fuels and lubricant, vessels for which suited and how placed therein, power, speed and consumption data; a chapter on operation and upkeep; a discussion of various methods of operating the auxiliaries on board a vessel propelled by this type of engine; and a very complete set of illustrations.

Descriptions of the engine plants in various types of ships include many classes of vessels from lifeboats to oceangoing ships, among which the motor-propelled reinforced concrete ship and the aerial-propelled surface vessel are of particular interest. The author presents an excellent argument for motor-propelled vessels in tropical waters.

This book should be highly instructive and useful to ship owners and operators, and of considerable interest to naval officers.

R. S. H.

"American Guns in War with Germany." By Edward S. Farrow. Price $2.50 net. (Published by E. P. Dutton & Co.)

The author is well known to the army as a writer of military works, including a military encyclopedia and has presented in readable form the gigantic problems met by the Ordnance Department, U. S. Army, in the production of arms and munitions for the American Forces. To anyone desiring to have at hand in a handy form the statistics of ordnance production the book will prove of value. It is a popular record of one of the remarkable war achievements of this country in the field of sudden expansion where the finest and most accurate machine work was required. Guns of all calibers, small arms, ammunition of all sorts, equipment such as limbers, caissons and tractors, sighting and fire control equipment of the most accurate sort, bombs, grenades, projectors, periscopes, and tanks, in fact the whole field of old and new devices for offensive warfare, are treated in most readable manner, and the result is well worth reading.

H. F.

"Diesel Engine Design." By H. F. P. Purday, B. Sc., A. S. G. I. Price $7.50. (Published by D. Van Nostrand Company, New York.)

This book written primarily for designers and draughtsmen will prove of interest to Diesel engine users and students.

Briefly, subjects taken up are Principles, Thermodynamics, Exhaust Suction and Scavenge, Similitude, Crank-shafts, Fly Wheels, Framework, Cylinders and Covers, Running Gear, Fuel Oil-Air-Exhaust-Compressed Air System, and Valve Gear.

One of the many interesting points brought out by the author is that the type of Internal Combustion Engine called Semi-Diesel is misnamed.

Two reasons are given for breakdowns of Diesel engines in marine work: (1) Steam engine plans are too closely followed; (2) designers assume a Diesel engine afloat radically differs from one ashore which is not borne out in actual practice.

The author states that indicator cards are even more important in Diesel engines than in steam engines.

The subject is clearly presented with numerous excellent sketches and references for details are given at the end of each chapter.

H. J. S.

"Fifty Years in the Royal Navy." By Admiral Sir Percy Scott. (Published by George H. Doran Company, New York.)

Admiral Sir Percy Scott, author of "Fifty Years in the Royal Navy," is well known to American naval officers. His brilliant career, and particularly the part he has taken in the development of gunnery, assures this book the welcome and close attention it deserves.

These memoirs include a narrative of personal experience afloat and ashore. Scott entered the navy at the age of eleven and a half years, saw duty suppressing slave trade in the Indian Ocean, fought in the Ashantee War, and, while still a junior officer, made a cruise around the world. As

a lieutenant he made a reputation in mounting and handling naval guns in the Egyptian campaign. At a considerably later period the heavy ordnance landed from the ship he commanded in South Africa took an essential part in gaining the decision of the war of the Transvaal. From there he sailed to China; and Captain Scott's naval guns were again called into active service, this time during the Boxer Rebellion. Finally, in the World War he was assigned somewhat mixed duty in connection with naval gunnery and the defence of London.

All this makes good reading, interspersed as it is with entertaining anecdote and personal experience. But it is the more professional side of the work which gives it an important place in the naval book-shelf. This side points a lesson in preparedness.

In his preface Admiral Scott states: "This book has been written in vain if it does not carry conviction that our naval administration is based on wrong principles." The author then proceeds in vigorous and unmistakable terms to reveal, as he sees them, the faults in the British naval system and their consequences.

Amongst other things the history of "Director Firing" is told to illustrate damage done by ultra-conservatism, defective organization, and Admiralty mis-management. An idea of this can be gathered from the following passages.

(In 1905 Captain John Jellicoe was made Director of Ordnance, and Captain Scott Inspector of Target Practice.)

"During our time in office we not only managed to introduce many reforms in naval gunnery, but tried hard to introduce "director firing." Unfortunately the Director of Naval Ordnance was not a member of the Board of Admiralty, and consequently carried no weight as regards naval gunnery, and this very necessary method of firing was not generally adopted until seven years afterwards, when war proved that the guns in our ships were of no use without it, a fact which throws a very heavy responsibility on the Board of Admiralty, which boycotted its introduction in former years."

(In 1907 Scott was ordered to command the Second Cruiser Squadron of the Channel Fleet, and he continued to occupy himself with progress in gunnery.)

"My attention was devoted to fitting my Flagship, H. M. S. *Good Hope*, with director firing, so that if she had to fight a German there would be a chance of her remaining on the top, instead of going to the bottom. . . . . This operation was difficult, as I could get no assistance from the Admiralty, and was forced to beg, borrow, or steal all the necessary material. . . . . I succeeded so well that the *Good Hope* became like the *Scylla* and *Terrible* in other years, top ship of the navy. . . . . But when I left the squadron on February 15, 1909, the routine I had instituted, and the 'director firing' I had installed, were put on the scrap heap, and the old method reinstalled. . . . . That is one way we had in the navy—a determination to fight against any change, however desirable."

As a sequel to the obstruction and delay encountered in introducing director firing Scott refers to the British disaster off Coronel which occurred in the first months of the great war seven years later:

"On November 1, 1914, my old ship, the *Good Hope*, in company with the *Monmouth, Glasgow,* and *Otranto* engaged the German cruisers *Scharnhorst, Gneisennau, Leipsig,* and *Dresden,* in the Pacific. After a short action the *Good Hope* and *Monmouth* were both sunk by German superior shooting. These ships were caught in bad weather, and as neither of them was fitted with any efficient system of firing their guns in such weather, they were, as predicted in my letter to the Admiralty of December 10, 1911, annihilated without doing any appreciable damage to the enemy.

"These two ships were sacrificed because the Admiralty would not fit them with efficient means of firing their guns in a sea-way. Had the system with which I had fitted the *Good Hope* been completed and retained in her, I daresay she might have seen further service and saved the gallant Cradock and his men on this occasion."

To clinch his argument Scott then tells of an official inspection visit paid by him to the Grand Fleet in November, 1914. The condition of things was not found satisfactory, and of this he writes:

"I had a conference with the First Lord (Mr. Winston Churchill) and the First Sea Lord (Lord Fisher), and pointed out to them the serious state of affairs, and how badly we should fare if the German Fleet came out. They realized the position and approved of practically all of the ships being fitted with director firing; and further, they agreed that I could arrange it without being held up by the ordinary Admiralty red tape. Consequently the fitting of the ships went on rapidly, and had the 'push' been maintained, our whole fleet would have been equipped by the end of 1915.

"In May, 1915, unfortunately for the nation, Lord Fisher left the Admiralty and all the 'push' ceased. I no longer had any influence; the authorities went back to their apathetic way of doing things; time, even in war-fare, was not considered of any importance by them. . . .

"At the Battle of Jutland, fought on May 31, 1916, the commander-in-chief had only six ships of his fleet completely fitted with director firing—that is, main as well as secondary armament; he had several ships with their primary armament not fitted; he had not a single cruiser in the fleet fitted for director firing; he had no Zeppelins as eyes for his fleet; his guns were outranged by those of the Germans. He had to use projectiles inferior to those used by the Germans; and in firing at night he was utterly outclassed by the enemy.

"One would have thought that, although their Lordships paid no attention to my warning in 1911, the moment the war was known to be inevitable, they would have bestirred themselves and ordered all the material necessary to put the fleet in a state of gunnery efficiency.

"And before I leave this subject of the unpreparedness of the Grand Fleet in some respects for war, I must revert to the criticism of Lord Jellicoe for not pursuing the German Navy after the battle of Jutland and fighting them on the night of May 31–June 1. Lord Jellicoe had a very good reason for not doing so. The British Fleet was not properly equipped

for fighting an action at night. The German Fleet was. Consequently, to fight them at night would only have been to court disaster. Lord Jellicoe's business was to preserve the Grand Fleet, the main defence of the Empire, as well as of the Allied cause—not to risk its existence. I have been asked why the Grand Fleet was not so well prepared to fight a night action as the German Navy. My answer is, 'Ask the Admiralty.'"

This is a serious charge against the Admiralty and many will question whether or not all responsibility rests there. It may be that the Admiralty only expressed a conservatism prevailing throughout the service and a general naval system which resisted change and progress. It may also be added that the author himself showed intolerance of modification to his suggested schemes and methods.

"Admiral Scott emphasizes the importance of concentrating effort on preparing the navy for war, and points out the danger of unwisely diverting peace time activities into other channels.

"Training naval officers and men as housemaids is not good for war; *Brains* are required. But however faulty our training in peace may have been, it did not effect the character of the British naval officer and seaman. Whether in a ship, submarine, balloon, aeroplane, motor car, tank, or as a soldier, the men who bore an anchor on their caps, and others who wore a sou'wester fought with a bravery not surpassed by any men in the world. Of the many thousand who went to the bottom of the ocean, a large number might have been alive now if in peace-time our legislators had attended to the war-preparedness of ships instead of chiefly to the housemaiding of them. I once heard a statement that "the blunders of our politicians and legislators are paid for with the blood of our soldiers and sailors." How terribly the war has demonstrated the truth of this statement!"

In the closing chapter the author gives sensational opinions on submarines which are by no means concurred in by the concensus of naval opinion. On the subject of gunnery, however, Scott speaks with authority. As gunnery officer, as captain, and as admiral, his ship headed the navy list in target competition. Results show his diligence and enthusiastic interest in the development of team-work and skill. The experience of war has proved his wisdom on the subject of director firing.

These are considerations which will cause naval officers and naval administrators to read carefully "Fifty Years in the Royal Navy."

C. C. G.

NOTICE TO MEMBERS

More members, both regular and associate, are desired. Any increase in membership invariably means a larger number of articles submitted, and consequently an improvement in the PROCEEDINGS.

You are requested to send or give the attached slip to some one eligible for membership, urging him to join.

By direction of the Board of Control,

H. K. HEWITT,
Secretary-Treasurer.

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Secretary and Treasurer,
U. S. Naval Institute,
Annapolis, Md.

Dear Sir:

Please enroll my name as a {*subscriber* / *regular member* / *associate member*} *of the U. S. Naval Institute from*..........................

Very truly yours,

____

____

For eligibility as to membership and for difference between members and subscribers see opposite page (Constitution).

Members are liable for dues until the date of the receipt of their resignations in writing.

Kindly check amount of remittance sent.

Membership dues (annually)		**$3.00**....
Subscribers dues (annually)		**3.50**....
ostage	**Foreign**	**.50**....
	Canadian	**.15**....

NOTICE

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It is now in its forty-seventh year of existence. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers upon subjects of interest to the naval profession, as well as by personal support.

On the subject of membership the Constitution reads as follows:

ARTICLE VII

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control. To be declared elected, they must receive the affirmative vote of three-quarters of the members represented at regular or stated meetings, either in person or by proxy.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control. The Board of Control will at each regular meeting ballot on the nominations submitted for election, and nominees receiving a majority of the votes of the board membership shall be considered elected to membership in the United States Naval Institute."

Sec. 8. The annual dues for regular and associate members shall be three dollars, all of which shall be for a year's subscription to the United States Naval Institute Proceedings, payable upon joining the Institute, and upon the first day of each succeeding January. The fee for life membership shall be forty dollars, but if any regular or associate member has paid his dues for the year in which he wishes to be transferred to life membership, or has paid his dues for any future year or years, the amount so paid shall be deducted from the fee for life membership.

ARTICLE X

Sec. 2. One copy of the Proceedings, when published, shall be furnished to each regular and associate member (in return for dues paid), to each life member (in return for life membership fee paid), to honorary members, to each corresponding society of the Institute, and to such libraries and periodicals as may be determined upon by the Board of Control.

The Proceedings are published monthly; subscription for non-members, $3.50; enlisted men, U. S. Navy, $3.00. Single copies, by purchase, 30 cents; issues preceding January, 1920, 50 cents.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ARTICLE, 1921

A prize of two hundred dollars, with a gold medal, and a life-membership (unless the author is already a life member) in the Institute, is offered by the Naval Institute for the best original article on any subject pertaining to the naval profession published in the PROCEEDINGS during the current year. The prize will be in addition to the author's compensation paid upon publication of the article.

On the opposite page are given suggested topics. Articles are not limited to these topics and no additional weight will be given an article in awarding the prize because it is written on one of these suggested topics over one written on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. All original articles published in the PROCEEDINGS during 1920, which are deemed by the Board of Control to be of sufficient merit, will be passed upon by the Board during the month of January, 1921, and the award for the prize will be made by the Board of Control, voting by ballot.

2. No article received after November 1 will be available for publication in 1920. Articles received subsequent to November 1, if accepted, will be published as soon as practicable thereafter.

3. If, in the opinion of the Board of Control, the best article published during 1920 is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention," or such other distinction as the Board may decide.

4. In case one or more articles receive "Honorable Mention," the writers thereof will receive a minimum prize of seventy-five dollars and a life-membership (unless the author is already a life member) in the Institute, the actual amounts of the awards to be decided by the Board of Control in each case.

5. It is requested that all articles be submitted typewritten and in duplicate; articles submitted written in longhand and in single copy will, however, receive equal consideration.

6. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

H. K. HEWITT,
Commander, U. S. N., Secretary and Treasurer.

TOPICS FOR ARTICLES

Suggested by Request of the Board of Control

"Rebuilding the Navy's Enlisted Personnel, and Reestablishing Its Morale and Spirit After the Serious Slump Caused by too Rapid Demobilization and High Wages in Civil Life."
"The Human Element in the Administration of Discipline."
"A Demobilization Programme for the Future."
"The Mission of the Naval Academy in the Molding of Character."
"Health of Personnel in Relation to Morale."
"Physical Factors in Efficiency."
"The Naval Officer and the Civilian."
"Naval Bases, Their Location, Number and Equipment."
"Military Character."
"The Ability to Handle Men a Necessary Element in the Equipment of a Naval Officer."
"The Relation of Naval Communications to Naval Strategy."
"The Relation of Naval Communications to Naval Tactics."
"The Training of Communication Officers."
"The Organization of a Naval Communication Service."
"The Naval Policy of the United States."
"A Review of the Battle of Jutland with Lessons to be Learned Therefrom."
"Modification in the Design and Armament of Ships to Meet the New Conditions of Aerial and Subsurface Attack."
"Coordination of Surface, Subsurface and Aerial Craft in Naval Warfare."
"Our New Merchant Marine."
"Submarine Warfare, Its History and Possible Development."
"Escort and Defense of Oversea Military Expeditions."
"A Proposed Building Programme for the U. S. Navy, Including an Efficiency Air Service."
"Naval Organization from the Viewpoint of Liaison in Peace and War Between the Navy and the Nation."
"The Ship's Company—Its Training, Discipline and Contentment."
"The Principles of Leadership of Naval Personnel."
"Morale Building."
"The Value of Facility in Exposition—Verbal and Written—for Naval Officers."
"Discipline as Affected by the Human Relation."
"The Value of Pep."
"Navy Spirit—Its Value to the Service and to the Country."
"The Influence of the Term of Enlistment on the Efficiency of the Service."
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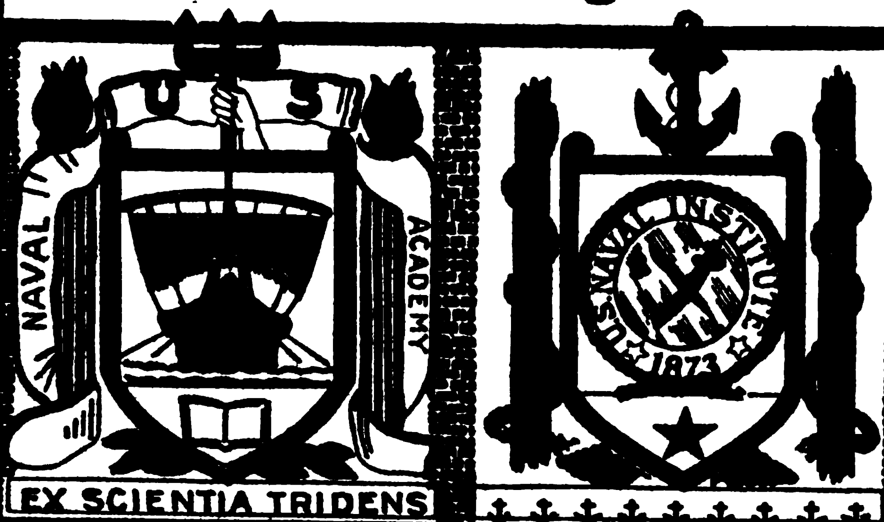

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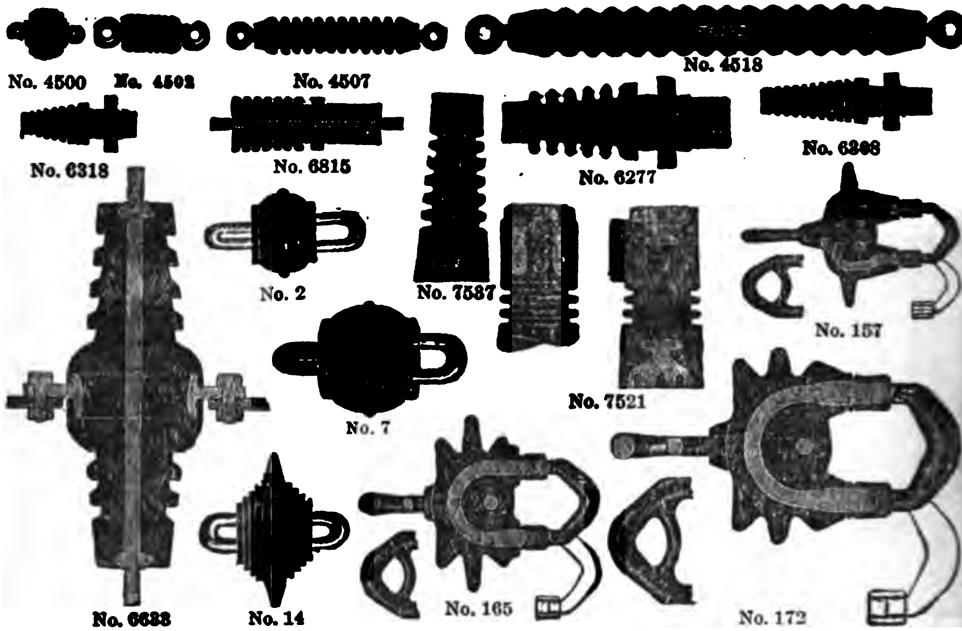

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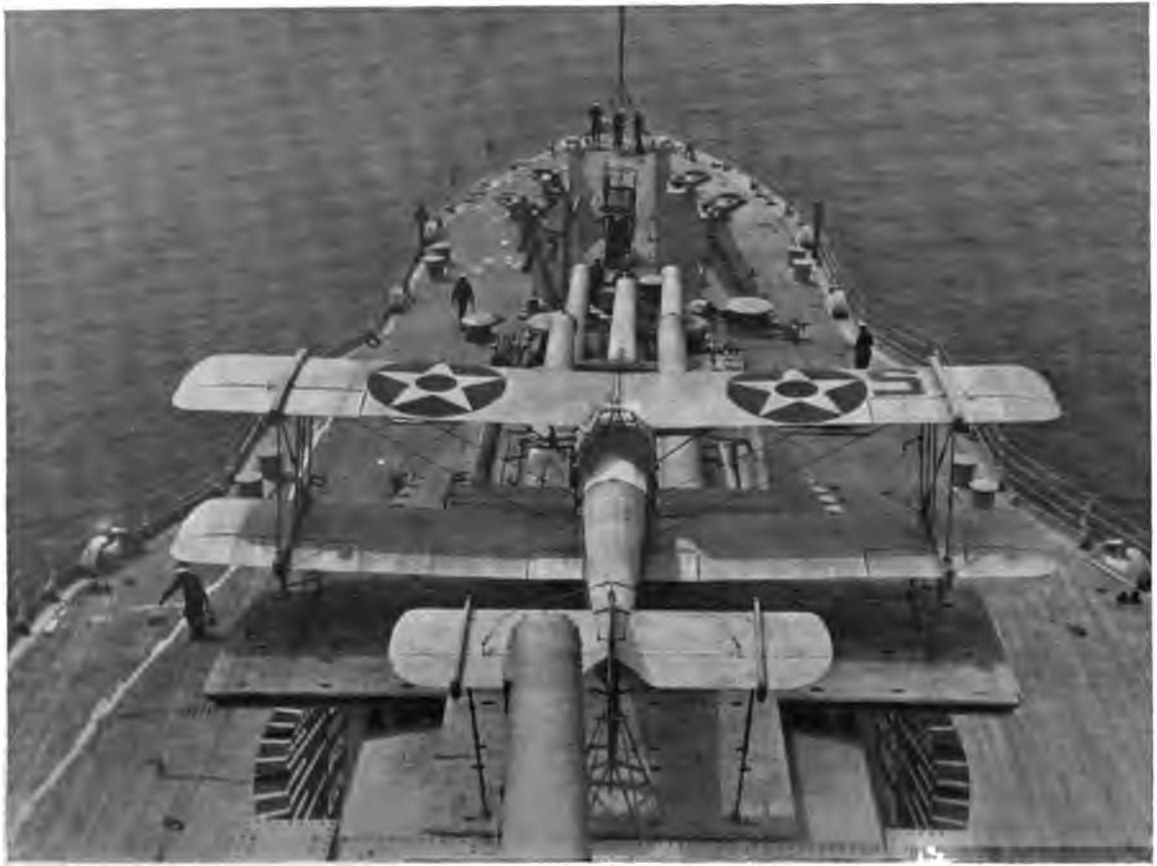

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

FORMS OF GOVERNMENT IN RELATION TO THEIR EFFICIENCY FOR WAR

By Rear Admiral A. P. Niblack, U. S. Navy

General Considerations

In our diplomatic relations with countries it is essential that we study forms of government. Other governments, recognizing the complexity of our own system, send to Washington selected persons as ministers or ambassadors and, with the view of solving other difficulties, often select those with American wives. Had the governments associated with us in the late war fully understood that our President practically shares the treaty-making power with the Senate, they would probably have pursued a different course in framing a treaty in Paris. If misunderstandings, therefore, arise among statesmen from such elementary causes, it is important that we examine the forms of government of at least the principal powers, such as Great Britain, France, Japan, and Germany, with which our future relations are so important.

It would be bold to say that the war just fought out was fundamentally between England and Prussia not only as dominating their associates in their respective governments, but as political and commercial rivals in Europe and in the world, but in April, 1848, in the House of Commons, Disraeli stated that the commercial and political importance of the rising state of Prussia on the North Sea should not pass "unnoted and uncensured" by

England, and so we may assume that this merely voiced an uneasiness rather than foresight. It might seem, therefore, that the first demand of the Allies in the peace settlement would naturally be the assurance that Prussia should be divided up into smaller states as being too large and too dominant a factor in Germany. It is here shown, on the contrary, that the new German Constitution has effected this without the intervention of the Allies, and it would seem that the German people themselves recognize the undesirability of the former political arrangement. A study of the new German Constitution will further show that it embodies all of the advantages of our own, while avoiding many of the clumsy features of both our own and the German Constitution of 1871, which, in both cases, were due to compromises which had to be made to effect confederation or federalization of sovereign states into a union of states.

Probably the most interesting study is the Japanese Constitution, which is now threatened with changes growing out of the march and trend of world conditions. The business and industrial classes are growing in power and influence, and a struggle with the military party now in control is inevitable. In all sympathy, one can but recognize that the problem in Japan is to first make it safe for democracy, since the question is one of the gradual surrender of autocratic power into the hands of the people only when they are fit to be entrusted with it, and is not one of abstract right, since national safety is the highest obligation. After all, constitutional government is only of recent development and only in the experimental stage. There is no more sacredness in constitutional government than there is such a thing as the divine right of kings. In Japan the Emperor is still sacred, and China disappointed and offended the sentiment of the Japanese people when it became a republic. The monarchic form of government suits some countries better than would a republic. However little real political power the King of England may actually exercise in England itself, he is nevertheless the Emperor of the British Empire. If the crown did not exist it would be quite logical to create it, and the stability of the throne in England comes from pressure from without as well as from support within.

One of the best features of our own Constitution is the sacredness with which it is regarded, due to the high respect we have had for the framers of this wonderful instrument, but the elec-

toral college, the length of the presidential term, the status of the cabinet officers, the undue powers of the Senate, and legislation by committees of Congress are matters which admit improvement in the direction of fixing responsibility and improving the efficiency of our government. We have local self-government carried to its legitimate conclusion. Each township, city, county, and state gets very much the government it deserves, but the powers given to the unequal states through equal representation in the Senate infringes too much the authority of the central government and curbs too much the democratic and representative character of the House of Representatives. Local self-government is too often interpreted to mean an absorption in local affairs to the exclusion of grave international considerations. Local political considerations due to the necessity for re-election is the penalty we must necessarily pay for representative government in the House of Representatives, but, when party politics invade the Senate, it has a baleful effect upon our international relations and tends to reveal our country to the world as rather narrow and provincial.

The Senate is too much of a tradition. Tradition is a splendid thing for it is the teaching of the elders. The code, the culture, or "kultur," under which we live and anything which preserves us true to the traditions of the pioneers who founded this government of the people for the people and by the people is a good thing, but the Senate, through its committee organization, is not responsive enough. As cabinet officers are not responsive to popular demand and not removable by any other process than the will of the President, or by impeachment, some branch of the government must be responsive and certainly the Senate is least so. We, of course, in these United States, really live under the British tradition, just as countries in Central and South America still live under the Spanish tradition. Our weights and measures, our literature, our common law, our social customs of making the first visit, our clothes, our language, our various religions, and many of our sports have come down to us from colonial days, but this study will show the striking dissimilarity of our forms of government. The basis of friendship of the two great English-speaking peoples is rivalry and independence of each other, and these are the really true and lasting bases of all friendships. The instant the condition of dependence arises between two equals the essence

of friendship is lost and another relation takes its place but it is not friendship. There is no necessity for an alliance between Great Britain and the United States, and there probably never will be one, but, in effect, it exists, or must exist, through conditions which are arising in the world and which will hereafter necessitate that the two countries stand together; otherwise, they may fall together.

In the discussion of forms of government which follows, the view is taken that the highest obligation is national safety and national defense. This is not a militaristic view, but a statesmanlike one. It is distasteful only to politicians whose view is that the highest obligation is the success of the party to which they belong. To the politicians we must credit many of the subtle changes in the spirit of constitutional governments which take the form of "jokers" in the government, which we must be on our guard to detect. In considering governments in relation to their efficiency for war it is a curious fact that we find the army and navy, as a rule, not in sympathy with the politicians, and the politicians not in sympathy with the army and navy. It is probably because their codes are different.

THE "JOKER"

In considering the form of government of any country in relation to its efficiency for war, its ability to maintain preparedness for war, and its organization for conducting the operations of war, it is not necessary to go back beyond constitutional government, as all modern governments are at least constitutional in form. Nor need we consider forms of government other than those of the principal powers. The main thing is to be able to detect the "joker" in the real government whereby, under any form of constitutional government, there may lurk a centralized power which silently directs governmental action, for it is very important to realize that a written constitution is merely a proposed plan of "government by law" instead of by an individual or clique, and does not necessarily disclose the actual workings of the government, because, in growing or expanding countries, the government is apt to find itself hampered by constitutional restrictions, like a suit of clothes which it is always outgrowing, and the tendency is always, therefore, towards modifying the

rules of the game to suit new conditions, if not to over-ride the constitution itself. We will see later on that it is important even to study the methods by which modifications or changes in the constitution may be brought about as indicating how deeply the "joker" is intrenched.

CONSTITUTIONAL GOVERNMENT

The history of constitutional government is briefly as follows: The English Revolution was the first to establish the theorem that sovereign power rests in the people and not in the crown and that the function of the head of the state is merely to execute the will of the people. It did not bring about a written constitution and the existing system of government in England may be said to date only from the Reform Bill in 1832. America was the birthplace of written constitutions and the Constitution of the United States is the oldest written one in the world to-day, as it dates back to 1787, while that of Italy dates from 1848; of the former Austro-Hungarian Empire from 1870; the German Empire from 1871 and now 1919; France from 1875; and Japan 1889.

In most written constitutions the powers of the central government, or of the ruler, and of the individual states, are enumerated, and the powers not enumerated are reserved for the other branches of the government. In such cases it is necessary to have some form of high court to determine whether laws enacted by the central government or by the states are in conformity with the constitution, in case of dispute as to the validity of any law. Experience has shown, in the United States, that the central government has not had enough power and that federalization has not worked well for national safety, because of the too strong local self-government. There have also been constant appeals to the Supreme Court of the United States and the higher courts of the states. In other words, modern ideas are somewhat against federalization and a too minute enumeration of the powers of either the central government or the separate states. The South African Union Act of 1907 is an excellent example of written constitutional government, in that it abandons, or rather avoids, the difficulties of federal government by not enumerating the powers of either the separate states or the central government, but places all power in the Union Parliament which is permitted to delegate

power in part to any of the states of the union. The Union Parliament may at any time prescribe the laws for any one of the separate states, if it is not satisfied with those which the state itself is being governed under. It, to a large degree, copies what the British Government has practically become under the working out of the Reform Bill of 1832 and the subsequent acts of Parliament carrying out the electoral reforms, which reforms were really only superficial. They merely lowered the property qualifications, gave democratic local self-government to boroughs, parishes, and counties, but, with it all, Parliament dominates the local governments and may sweep them all away with a single act. *The democracy of England is in its assertive individualism and exists very slightly in its government.* As will be seen later, there are almost no points of resemblance between the forms of government of Great Britain and the United States of America.

UNIONS

Nearly all modern states are combinations or unions of smaller ones, which a common danger or political exigency have united. There are, however, all degrees of union. Speaking only of the so-called Great Powers of the world, we find in Italy and France a complete consolidation of former independent countries without federalization. In view of the wars and rivalries of the separate states and provinces comprised in modern Italy and France, this is surprising. In the United States and in Germany, we find a federalization of separate and sovereign states. In the United States imperfect federalization cost us five years of civil war. In Germany the individual states, under the constitution of 1871, enjoyed too much independence of the central government. In the new constitution, promulgated in August, 1919, the still so-called "German Empire" is declared to be a republican state, with sovereignty residing in the people and, while individual states will enjoy legislative rights, the imperial law will govern. This is a long step towards centralized efficiency, and the newly promulgated German Constitution avoids the weakness of the former empire in this respect.

The United Kingdom of Great Britain and Ireland, on the other hand, is a very imperfect or loose union, in which Scotland and Wales enjoy wide liberties and Ireland is always seeking impossible independence. Japan has no existing traces of fed-

eralization. The tendency of federal government is always to extend the powers of the central government at the expense of the component states, and it is a curious fact that federalization is really not necessary to an efficient government, provided the central government has the right to delegate authority to, or frame the form of government of, the various states or provinces. In the new German Constitution there are rules for altering the Empire territorially, providing that plebiscites shall be held in districts affected. This is a clever blow, or entering wedge, to lessen the power of the individual states, coupled as it is with the provision that Imperial law supersedes those of the individual states through this provision. The demand recently made by the Entente powers that the new German Constitution be modified was intended to prevent German-Austria from entering the German Empire. Evidently they regarded this new provision as to territorial changes as a direct invitation to Austria to enter the German Empire. Under the terms of the new constitution, the former Bundesrath becomes the Imperial Council composed of representatives of the individual states, which will have at least one vote apiece, but no state can have more than two-fifths of the total number of votes in the Council. The Imperial Council has much less authority than the former Bundesrath, and, while far from being a Senate or second legislative body, its share in the control of the budget gives it the necessary vitality or virility.

Check and Balance

The theory of the United States Government is based upon that of "check and balance" by means of a division of powers between the Executive, Legislative and Judicial branches. Neither may perform the duties of the other. The Executive cannot initiate legislation, but can veto. The Legislative branch cannot pass a law which is effective if the Judicial branch decides that it is contrary to the Constitution. Whereas, in other countries, constitutions have been brought in force to restrict the powers of the crown, the authority of the President of the United States is prescribed in the Constitution (or in other words his powers are enumerated) and Congress has always been willing to increase these powers by special acts rather than to restrict them. In other countries, except Germany and Japan, the restriction of the powers of the ruler, and the prevention of clashes between the legislative and

executive branches has led to the holding of cabinet ministers responsible for the executive acts of the head of the government. It is the cabinet which gets blamed and goes out of office. This is known as the Cabinet or Parliamentary form of government, as distinguished from the Presidential, and it has the effect of weakening the executive power of the ruler even to the point, in some countries, of rendering him a political "figure head." It is a curious fact that Germany, Japan and the United States are the three countries of the so-called Great Powers which have the Presidential form of government, in that the Cabinet is not answerable to the Parliament. In fact, Japan, the United States and Germany (under the former and present constitution) are similar in most of their forms, but in Germany and Japan it is provided in the constitution that a responsible minister must countersign all executive acts. There is, however, in none of these countries, a collective responsibility of the cabinet ministers to the legislative bodies. On the contrary, the responsibility is to the executive and only individual ministers may be held answerable to the legislative body, usually by impeachment proceedings, or a direct vote of censure.

THE OFFICE OF PRESIDENT

The United States differs from all other Great Powers in that the President is responsible for all of his own executive acts, and his Cabinet is not at all responsible for them. He may be impeached, and he can be, and often is, defeated at the poles for re-election. It is observable that a President is usually bolder in his second term than in his first, because he cannot count on being re-elected for a third term. The thing which baffles and puzzles all foreigners is that the President is, on the one hand, the leader of his political party, and, on the other, he is the impartial ruler. The President goes before the country just as the Prime Minister of a Cabinet does in parliamentary countries, to advocate or defend his policies. He has so much power because Congress and the people give it to him by special legislation in many cases. Besides, as leader of his party, he may and often does use pressure on individual legislators to change their views. Historically, however, when there has been conflict between the President and Congress, and the President has toured the country to carry his policies against Congress, he has invariably failed. Whether or

not it is a desirable thing to give the Chief Executive so much power is apart from the question, for there are very essential restrictions on the powers of the President, such as requiring the nominations of all appointees, even cabinet officers, to be submitted to the Senate for their approval. All treaties have to be approved by the Senate. A declaration of war can only be made by Congress. Legislation can only be initiated by Congress itself, and the President is restricted to proposing legislation by messages to Congress. The "joker" in our government is in the power given to the President and Cabinet through censorship, through patronage, and through official pressure, which, on the one hand, may be used to strengthen the country in its foreign relations and in national safety, but, on the other, may risk the national safety for party expediency. In all fairness it should be said that the Presidential form is practically open to less abuses of this kind than the Parliamentary, and, above all, rightly understood, our government may easily be made the most efficient in the world for military preparedness without the invasion of any one's real liberties or rights, to the perpetuation of our free institutions, and with the participation of individual citizens in obligations as well as in the benefits of the democratic form of government.

THE NEW GERMAN CONSTITUTION

An analysis of this instrument will show that it is a masterpiece in written constitutions and reflects great credit on Dr. Hugo Preuss, its reputed author! It may be well to state briefly some of its fine points.

The members of the Reichstag are elected for four years. The President is chosen by the entire German people and for a term of seven years. As before stated, the President's executive acts must be countersigned by the Chancellor or the Cabinet Minister whose department is affected, but the Chancellor and Cabinet are selected by the President. The President, Chancellor, and Minister are, however, only subject to the will of the Reichstag through impeachment by proceedings which can be instituted only after signature by at least 100 members of that body. If the President so desires, laws may be submitted to the people direct, and, if approved, they have the same force as if enacted by the Reichstag. The constitution can be altered by a quorum of two-thirds

of the Reichstag voting for alteration by a two-thirds majority. The "joker" in the new German Constitution is therefore that it gives to the Reichstag the power peacefully to overthrow the government by a two-thirds majority of a quorum, and thereafter constitutionally to install a King or an Emperor in place of the President. Another "joker" which the Entente has protested is the possible and easy admission of Austria into the German Empire under the plebiscite clause of the constitution.

The "joker" in the former German Constitution was that there were 17 votes for Prussia in the Bundesrath out of a total of 58, which 17 votes could defeat an amendment to the constitution, and all existing arrangements would continue in force and also all laws concerning the army and navy and taxes, if the Prussian delegates so voted. This practically placed the veto power in the hands of the Prussian members of the Bundersrath, and the Emperor personally appointed these members. Contrary to the popular idea, however, the late German Emperor's powers, either in legislation or in military matters, were slight when compared with those of the President of the United States or the Emperor of Japan. He executed the laws, but his personal influence and freedom of speech were extra-constitutional in reality. He could not dictate policies, but he could replace the Chancellor, the Chief of the General Staff, and all the Cabinet Ministers, etc., and, in the end, gain his point very much as the President of the United States may do.

DEFINITIONS

So far, we have pointed out that there are no traces of federalization in some countries, and, in others, a loose union holds countries together; that where check and balance is seemingly absent from any government, the cabinet may be overturned by an adverse vote or by a political crisis, as in Japan; that local self government is not incompatible with strong centralized government; that the cabinet form of government does not go with a bicameral legislature of equal powers; and that it is not idle talk to speak of "jokers" in forms of government; but, in order to definitely analyze the various forms of government, it is necessary to resort to definitions.

IMMEDIATE OR REPRESENTATIVE

I. In the first place, we speak always of Representative government. The opposite of this is Immediate.

In the Immediate form of government, which may be monarchic, aristocratic, or even democratic, the state exercises directly the functions of government. It is, therefore, unlimited in form, and may be as despotic as it wishes, as the state and the government are practically identical. Strange to say this is, in effect, the actual form of the British Government which is Immediate.

Representative government is that form in which the state vests the power of government in one or more organizations more or less distinct from its own organization. It too may be unlimited or limited according as all or only a few of the population of the state are made eligible to hold office or mandate. This is something different from the right to vote, which is also restricted in most countries. In other words, the word "representative" implies the degree of eligibility to hold office rather than merely the right to vote.

UNLIMITED OR LIMITED

II. It will be noted that there is a fundamental distinction, scientifically speaking, between the state and the government of a state. In ordinary conversation no such distinction is usually made. It is sufficiently accurate for our purpose to say that the state is somewhat of an abstraction but represents the sovereign power, and the government is the administrative machinery.

If the state vests its whole power in the government, the form of government may be said to be *unlimited*. If, on the other hand, the state confers upon the government less than its whole power, less than practical sovereignty, either by enumerating the powers of the government, or by defining and safe-guarding individual liberty against this delegated power, the government is *limited*. It does not imply that an unlimited form of government is a despotism, nor that the limited form of government may not actually be twisted into despotism. It is merely a distinction as to the general tendencies, as all governments are now constitutional in form and no despotism should be really possible.

CENTRALIZED OR FEDERAL

III. Next we come to the manner in which the governmental power is either centralized or distributed, or in other words, whether it is the centralized or the federal system of government.

Centralized government is that form in which the state vests all government authority in a single organization, and there are no independent local governments or quasi states in which local governments may be established, modified or displaced at will by the central government. (Great Britain is of this type and it is important to note that a government may be centralized in form but not immediate or unlimited. It equally may be immediate and limited and not centralized.)

Federal government, in counter-distinction to centralized, is the form in which the state distributes the power of government between two classes of organizations as fixed in a constitution limiting the powers of each. This is the confederate and federal form of government, in which sovereign states retain a certain measure of local self-government and independence in local matters, but are under a strong central national government in all essentially national matters. The confederate form is the transient one where sovereign states unite, as in Germany in 1870, leading gradually, as in the United States and in the new German Constitution, to federation and gradual centralization of power in a central government, while retaining a measure of local independence of the units.

CONSOLIDATED OR CO-ORDINATED

IV. There is a further and finer distinction as to the distribution of governmental power in the central government or state itself, viz., consolidated or co-ordinated. In the consolidated form of government the state confides all governmental power to a single body. (In England practically all authority is vested in Parliament, which implies that the House of Lords is a part of Parliament. Everyone knows, however, that the House of Commons really governs Great Britain, and the British Government is therefore consolidated in form.)

In the co-ordinated form of government, the state distributes the powers of government between separate departments or bodies, each equal, independent of, but co-ordinated with, the other or

others. The United States is the best example of this, where there is check and balance between co-ordinate branches of the government.

HEREDITARY OR ELECTIVE

V. As to the tenure of persons holding office or mandate, the distinction is made between hereditary and elective. Hereditary is self-explanatory. Elective means chosen by the suffrage of enfranchised persons, whether or not the franchise is by universal suffrage or by the most restricted kind of suffrage, as in Japan. Elective need not necessarily imply democratic. In the degree in which a country is democratic, the governing group has to get the assent and support of large masses of the people. Where things are done which run counter to the inertia, bias and apparent interests of the masses, the elections which follow are apt to express the will of the people. Where, by political manipulation, the people are deprived of their right to express their will, we have the form but not the substance of democratic government. Where the right to vote is restricted abnormally, as in Japan, it is merely a fiction to call the government really elective.

Where there is mixed elective and hereditary tenure, there results several forms of government which depend upon the degree of consolidation and co-ordination. In the monarchic form, the state is represented by a single person. Where there are also a number of persons holding hereditary mandate or tenure of office, it becomes also an aristocratic government. When the state throws wide open the eligibility of persons to have membership, voice and vote in the governing body, it is democratic. Thus England is monarchic through its King who has no political power; aristocratic through its House of Lords which has a dwindling political power; and is supposedly democratic through having a House of Commons elected through restricted suffrage, but the "joker" in the British Government, as will be shown later, is that it is in effect an oligarchy, and its democracy is more or less a figure of speech, since all the democracy is in the local self-governed boroughs and not in the government. This is merely a personal view, and not necessarily the accepted one.

PRESIDENTIAL OR PARLIAMENTARY

VI. There is finally a very vital distinction between forms of government in the relation of the legislative to the executive power, and, for convenience, the two forms are characterized as either *presidential* or *parliamentary*.

In the *presidential* form the state regards the executive head of the government as an individual quite independent of the legislature or parliament, both in tenure of office and in prerogatives, and furnishes him with sufficient power to prevent the legislative body from encroaching. This is the form of the Japanese, the old and new German, and the United States Governments, in which the Mikado, German Emperor (now German President) and our President execute the laws.

This is a highly practical form of government. It is conservative and fixes the responsibility upon a single person. It is energetic because not subject to divided council. It is powerful, in that a single capable person is not unduly limited by a division of counsel and difference of views, and his decision must be obeyed.

In the *parliamentary* or *cabinet* form, the state confers upon the legislature the complete control of the administration of law. The cabinet of ministers is responsible for the execution of the laws, that is, it represents the sovereign in the exercise of executive power. The cabinet is dependent upon the will of the legislative body, and an adverse vote puts the members out of office. This constitutes the "check and balance." As there are, in most countries, two independent legislative bodies to give validity to any act, the control of the administration or execution of the act naturally gravitates to that house, which, by custom or the constitution, has the greatest power over the revenues of the government. The cabinet form of government in effect destroys practically the independence of one of the two houses of the legislative bodies. It makes legislation easy, but it is inconsistent with a definite policy, although it requires the members of the legislative body to have full information upon all subjects concerning which it must act, through the presence and voice of the heads of the administration in the legislative body. In our Congress this information goes to committees, and we thus have legislation by committees, as members of the House and Senate usually vote on the strength of reports made by their own different committees.

In general, cabinet or parliamentary form of government is weakening to continuity of policy. New ministries which are formed are commonly the result of the coalition of small political groups which are not long held together.

France in the last fifteen years has had ten ministries, and Spain many more. The two-party idea in Great Britain is what saves it from frequent changes, for the opposition party will not overturn the ministry until it is willing and able to take over the administration with a definite policy. In connection with our own government, it is again important to note that cabinet government is inconsistent with the existence of two legislative bodies of equal power, such as our House and Senate. The power of the United States Senate, through the provision of the Constitution whereby each separate state is represented by two Senators, makes it impossible for the House to dominate the Senate and the control of legislation really rests with the Senate more than with the House.

The two-party system in America also makes for stability because, where there are small minorities which can hold the balance of power between the two parties by throwing its weight with one party or the other, yet it can only defeat certain legislation but cannot overturn the government. We may, in fact, regard ourselves as extremely fortunate that we do not have the cabinet form of government, provided we reform certain weaknesses in the presidential form. In the United States the principle of the separation of powers was believed to make it impossible for the executive either formally to initiate legislation by introducing bills into Congress, or to participate either personally or by deputy in congressional debates, and even his veto can be overcome by a two-thirds vote.

Recent tendencies in the United States would, however, seem to show that the American system is changing and is coming to resemble more and more the Imperial System. The executive is growing more and more important and is exercising more and more influence, if not control, over the making of laws and the adoption of policies. This may or may not constitute a "joker," but little important legislation is now adopted by the United States Congress which does not have the support of whoever is President. What is true of the United States national government is also in a measure true of the state governments. State governors

are more and more influencing state legislation and state policy. Finally, our Presidents use their power to send messages to Congress as a means of forming or influencing public opinion. He also takes advantage of the opportunity to speak on important occasions such as large public dinners, the anniversaries of important public events and to tour the country to propose and support new policies. President Roosevelt is reported to have said that the President of the United States occupies the most influential pulpit in the world.

In all these ways, then, a President may exercise an influence, if not a control, over the members of Congress. Where a President's policies are approved by the people, it is not infrequently the case that showers of telegrams and letters descend upon members of Congress from those they represent, and do much to induce them to support the proposals of the President.

In making the choice between presidential and cabinet or parliamentary government the opportunities under the former, for lack of harmony and for conflict to develop between the executive and the legislature, must be offset by the inefficiency and lack of continuity of policy which may be expected to develop under the latter in those countries in which it is impossible to organize two strong political parties, upon one of which the cabinet may with confidence rely for support.

IN GENERAL

There is no great virtue or vice necessarily in any form of constitutional government except in so far as it protects the liberty of the individual, and on the other hand compels the individual to recognize fully his obligation to the state. Internationalism, Bolshevism, Radical Socialism, Pacifism, Unionism, Individualism and all the other ancient and modern *isms* fundamentally weaken the obligation of the individual to the state while demanding extreme liberty, or, in other words, demanding something for nothing. Governments are merely the way human beings group themselves for co-operation, for there must be co-operation and social cohesion in human society. The age of individualism has now definitely passed. Liberty implies obligation. Government implies obligation. Society implies obligation. Liberty is not the apotheosis of selfish individualism. The highest obligation is national safety and national defense. This is true whether we

regard the state as merely a great public service corporation, or as a sacred institution set over and above the people of the country. Executive efficiency, patriotism of individuals, and mutual co-operation of forces controlling the national resources of the commonwealth are the essential requirements of modern forms of government.

In 1532 Machiavelli expounded his theory of the state and the methods of securing its advancement. The doctrine he preached was that men should look for their safety to the state rather than to the church, and that the state should consist in absolute and irresponsible power vested in one man, who should embody its unity, strength and authority. To evolve a formula for testing constitutional governments in relation to their efficiency for war has nothing Machiavellian about it, but is a real patriotic duty.

The formula is as shown in the following form which is merely the summary of our definitions:

Forms of Government

Older	Compromise	Newer
Immediate	0	Representative
Unlimited	0	Limited
Centralized	0	Federal
Consolidated	0	Co-ordinated
Hereditary	0	Elective
Parliamentary	0	Presidential
Monarchic		
Aristocratic	0	Democratic
Oligarchic		

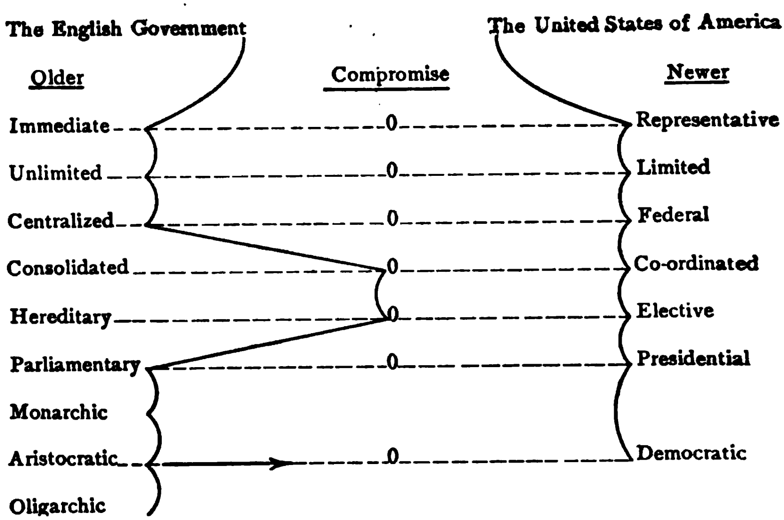
APPLYING THE TEST

It is now in order to test the forms of government of the most important countries with a view to comparing them as to their efficiency for war. We should not be surprised to find that in some governments there are compromises between two extremes. This we may indicate by the middle line.

THE GOVERNMENT OF THE UNITED STATES OF AMERICA

Professor John W. Burgess in his "Political Science and Constitutional Law," Vol. II, says: "This is substantially *representative* government. In the political system of the United States the state and the government are not identical; *i. e.*, that the government is representative. It is further, *limited* representative government. It is *democratic* representative government." He goes on to say that "it may be characterized as a federal presidential republic. It is a *representative, limited, federal, co-ordinated, elective, presidential, democratic* form of government." Professor Burgess is the highest authority on the subject and his view is here most unreservedly accepted.

Forms of Government



THE ENGLISH GOVERNMENT

While it may be more accurate to speak of the British Government than to call it the English Government, still it developed in England and is essentially English. The state and the government in England are identical, and it is Parliament. As there can be no such thing as an unconstitutional Act of Parliament the English Government is *immediate* and *unlimited*. No judge can pronounce its acts as unconstitutional and the liberty of the individual is completely at the mercy of Parliament. While it is

true that the Crown has an absolute veto this power has not been employed since 1707. It is true also that the Crown can create members of the House of Lords, but this power is really exercised by the Cabinet. Since 1880, about 289 peers have been created and there are over 700 members now of the House of Lords, or more lords than commoners. Moreover, the Crown can promulgate orders having all the effect of law, provided they infringe no Act of Parliament. For all this the English Government is utterly despotic in theory, however liberal it may be in practice.

There is no *federalization* in the British Empire. England rules it. There is no local government which the central government cannot legally modify, change, or even destroy. The government is therefore *centralized.* If we choose to regard the King as Chief Executive and the Parliament as the legislative branch we may say that the government is *co-ordinated.* It is safer to regard it as a compromise between *co-ordinated* and *consolidated.* It is really consolidated.

The English Government is partly *hereditary* and partly *elective.* It is *parliamentary* government, and the House of Commons has complete control of the administration. It is *monarchic,* and *aristocratic* in semblance, and only slightly democratic in reality.

To summarize: The English Government is *immediate, unlimited, centralized,* partly *consolidated,* and partly *co-ordinated,* partly *elective* and partly *hereditary, parliamentary, monarchic, aristocratic,* slightly *democratic,* and in fact *oligarchic.* This last assertion will be found true if we consider the following:

THE BRITISH CABINET

The ministers or cabinet are the chiefs of the party in power in the House of Commons. It may be said to be a committee and the most important committee of the House of Commons. While the right to introduce private bills is inherent in membership, yet the ministers have the sole right to initiate legislation and frame bills. By far most of the legislation originates exclusively with the ministers and their measures are not, as in the French Chamber of Deputies, referred to committees. The ministers are a committee, and the cabinet consists ordinarily of twenty-two members, who sit as said committee. Being administrative heads of departments, they do not all participate in the general sessions.

It follows that the Prime Minister, Foreign Office Minister, and one or two others are the oligarchy which governs the British Empire, although no money bills can be offered to the Commons without the approval of the cabinet as a body. The government is thus a party clique, existing for party ends. Party discipline is very strong and ministers do not like to risk unseating themselves by a new election. There is a further reason.

In addition to the twenty-two (22) members of the cabinet, there were, prior to the war, thirty (30) other ministers and fourteen (14) junior ministers. In other words there were, prior to the war, sixty-six (66) ministers of various kinds who went out of office with a change of party in an election. Their average salary was, prior to the war, £2700 ($13,000) per annum. Several positions carry with them a house, furniture, motors or horses, heating, lighting, servants, etc. The Lord High Chancellor, for instance, gets £10,000 per annum, and, if his party goes out of office, he may retire on a life pension of £5000 per annum.

It is interesting to note that during the war there was a coalition Cabinet and all the salaries were pooled and divided equally. There is no getting away, however, from the fact the Parliamentary form of government in England fails to give a continuity of policy, and England is always, as is the United States, in a state of unpreparedness for war through the lack of a steady policy and the mixing of strategic considerations with the exigencies of party politics. National safety being the prime function of government, its efficiency for war may be measured by the qualifications exacted from those appointed to high office. In England the highly trained permanent under-secretaries make this less important in Cabinet positions than with us, but we have a long way to go in our diplomatic missions. We may expect to see some form of federalization come about, as the House of Commons is too unwielding. Some decentralization is imperative in order to properly transact business, and the proposal to create two separate local governments in Ireland is in itself a form of federalization or may easily lead to it.

THE FRENCH GOVERNMENT

The government is *representative*. The state is represented by the National Assembly, which is a very different thing from the Chamber of Deputies and the Senate. The National Assembly

is separate from and supreme over the government, but the "joker" is that the government cannot change the constitution, but the Chamber of Deputies and the Senate may transform themselves into the National Assembly and then change the constitution. The French Government is *democratic* and is *centralized* as there is no distribution of powers between the central governments and the local governments, which may be swept by the central government at will. It is *co-ordinated* because a distinction is made in the constitution between the functions of the legislative and executive departments.

Forms of Government

The French Government

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Hereditary	0	Elective
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Monarchic		
Aristocratic	0	Democratic
Oligarchic		

The French Government is *elective* and *parliamentary*. The members of the House of Deputies are elected by universal suffrage and direct election. The President is elected by a joint assembly of the House of Deputies and the Senate and in case of impeachment it is prescribed that the House of Deputies prosecute and the Senate act as a court to try him. Every act of the President must be countersigned by a responsible ministry, but he has no veto power. His administration must be in political accord with the Chamber of Deputies no matter what the political majority may be in the Senate, the constitutional requirement that the ministry must be politically responsible to both chambers is

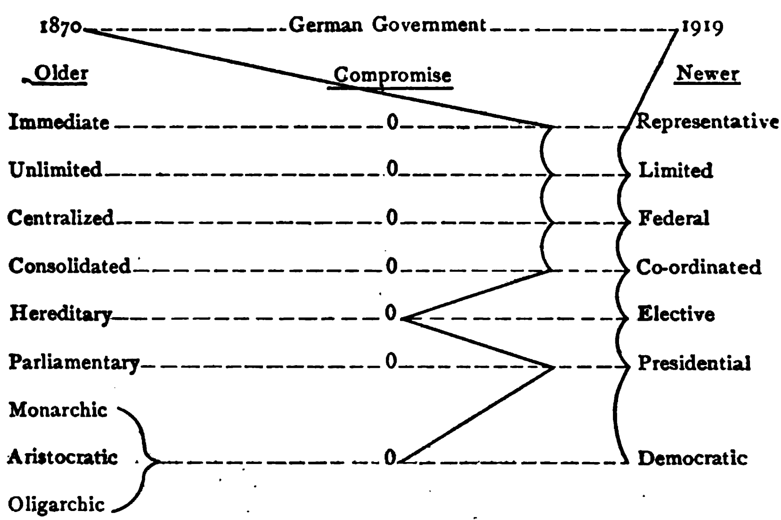
now a dead letter. The French Senate is without great influence in the French Government.

To summarize: The French Government is *representive, unlimited, centralized, co-ordinated, elective, parliamentary, democratic* government. While France is a republic the despotism of the Chamber of Deputies is undeniable. Thus we find in the Chamber and the Commons of France and England the despotic power bred of the French and English revolutions. (There is really no French constitution but a series of three constitutional laws passed in 1875.)

THE FORM OF THE GERMAN IMPERIAL GOVERNMENT

Although this government has now been changed and Germany is a republic, it is well to consider briefly its form. It was a

Forms of Government



representative government. The state and legislative bodies were distinct so that it was not *immediate*. It was a *limited* government because it was limited by the principles of the constitution. It was partly *democratic* and partly *monarchic*. It was a *federal* government exactly as in the case of the United States, the sphere of the *central* government being definitely given in the constitution and the states reserving all powers not mentioned in the constitution as belonging to the *central* government. It was, as

to tenure of office, partly *hereditary* and partly *elective*. It was a *presidential* government as distinguished from a *parliamentary,* as the ministers were appointed by the Emperor and the legislative body had no control over them. As pointed out, the right of the veto of the acts of the Reichstag really rested with the Prussian members of the Bundesrath. The Emperor could adjourn and prorogue the Reichstag, and we may therefore really designate the government as of the presidential form. We may summarize: The German Government under the constitution of 1870 was *representative, limited, federal, co-ordinated,* partly *elective,* partly *hereditary, presidential* form of government. It was quite as *democratic* as France, and much more so than England.

THE NEW GERMAN GOVERNMENT

The new German Government is *representative, limited, federal, co-ordinated, elective, presidential,* and *democratic* government.

The differences in the new constitution and that of the former one are in:

(1) The declaration that the German Empire is now a republican state with sovereignty resting with the people.

(2) The rules of international law are held as binding.

(3) The supremacy of the imperial law over the laws of the states.

(4) The Reichstag is elected for the definite period of four years and is not subject to dissolution by the executive.

(5) The President may employ the armed forces to quell disturbances and to compel any state to comply with constitutional requirements, but the Reichstag may veto this power in any given case.

(6) The President's executive acts must be countersigned by the chancellor or a minister.

(7) The Reichstag is given the right to impeach the President, chancellor, or any minister, but the charges must bear the signature of at least one hundred (100) members.

(8) The Bundesrath now becomes the imperial council with the power of Prussia curbed.

(9) The budget system is adopted.

(10) The entire postal telegraph and railroad systems to be taken over by the Empire and the states and the canals may be taken over in case the defense of the country requires it.

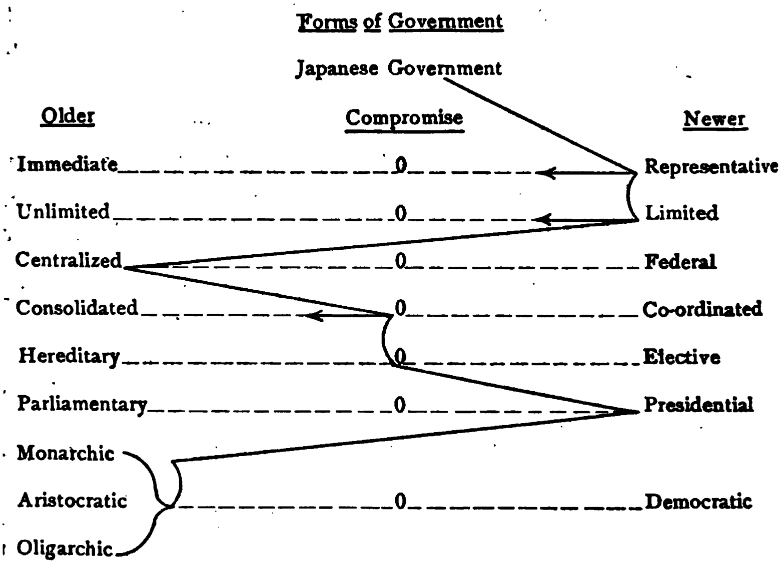
(11) Judges are chosen for life.

(12) Freedom of speech and no censorship except of moving picture films morally.

The new German Constitution is a chastened and model document but it remains to be seen how far it is more than a proposed program of procedure.

THE JAPANESE GOVERNMENT

In theory the Emperor of Japan gave the constitution to his people, and, while the constitution defines the powers of the



Emperor and he is advised by various bodies, such as the Elder Statesmen (the Genro) and the Privy Council, still, the individual members are appointed by him and, also, while the government is *representative* in form, because there is a distinction between the state and the government, yet it is really a centralized autocracy. One writer calls it "bureaucratic and autocratic." However, as the state and the government are not the same, we will have to classify the government as *representative* and as *limited* by the constitution.

The Japanese Government is *centralized*, as there is no trace even of federalization. As the powers are distributed by the con-

stitution between the Emperor and the Diet it is *co-ordinated* in form, but the Emperor really has so much power that the government is almost consolidated. The government would therefore be said to be partly *consolidated* and partly *co-ordinated.* It is also partly *hereditary* and partly *elective.* It is also *presidential* in form and partly *monarchic* and partly *aristocratic.* It is in no sense a *democratic* government, since in a city like Tokyo, of three million (3,000,000) inhabitants, the voting population is about twenty-four thousand five hundred (24,500). To summarize: The Japanese Government is a *representative, limited, centralized, partly co-ordinated,* and *partly consolidated, partly hereditary,* and *partly elective, parliamentary, monarchic,* and *aristocratic* government.

Discussion of the Form of Government of Japan

Professor Hart says: "Japan is ruled and ruled well. Nowhere can there be found a nation with a more distinct and persistent national policy. No country in modern times is so successful in carrying through great projects step by step. Everywhere there is good order, and everywhere, also, the mark of political power shaping the purposes of the nation." He omits to say, however, that the power that is shaping the purposes of the nation is largely military. Professor Hart also says, very truly, that "government does not rest ultimately on the consent of the governed but on its conformity to the will of the world spirit which makes and unmakes civilization."

It can only be a question of time when Japan will come in collision with the same forces which have compelled the German Government to conform to the will of the world's spirit which makes and unmakes civilization. Unfortunately for Japan she has taken Prussia as her model.

The Emperor reigns over and governs because he combines in his person the sovereignty of the state, descent from the gods, the government of the country and its people, and the political headship of the nation. It is true that his power is exercised through a cabinet and a bureaucracy to which are entrusted the routine of administration. Yet, even the Diet may be dissolved at any time and he has the absolute veto and alone has the right to propose amendments to the constitution. While members may

introduce bills into the Diet, the Emperor may withdraw such bills and amend them. To him belongs the power to organize and re-organize all the departments of the government, to appoint and remove officials, fix salaries, declare war, make peace, conclude treaties, proclaim a state of siege, confer titles, grant amnesty, promulgate ordinances which have the effect of law, and command the army and navy.

The Cabinet does not derive its powers from the constitution but from the Emperor, and it may be said that the Cabinet apparently really governs, since the Emperor has never refused his approval to any law which has been presented to him by the Cabinet. In Japan, as in the former German Empire, the Chancellor, or, as he is called in Japan, the Minister-President, is all in all, and the other ministers are relatively of less importance, thereby building up a political party of which the Premier is the actual leader.

The constitution provides that the Privy Council shall deliberate on matters referred to by the Emperor, but as the cabinet ministers' are *ex officio* members of the Council, the approval of the Emperor to a decision of the Council places it over the Cabinet, which may not question the decision. By incorporating the policy of the Cabinet in the procedure of the Privy Council, no interpolation may take place in the Diet, and thus is nullified the right of interpolation which the members of the Diet have.

In the constitution the Japanese "bill of rights" is incorporated, comprising fifteen articles out of the seventy-six that make up the constitution. These provide equal eligibility to office, liberty to change place of residence, freedom from arrest, trial, and punishment, the right to judicial trial, exemption of the house from liability to search, privacy of correspondence, inviolability of property rights, freedom of religious belief, liberty of speech, publication and association, and the right of petitioning the Diet. But in no instance does the constitution itself declare the conditions by which these precious privileges shall be enforced. In no case does it assign a penalty for the agent who shall contravene one of these rights. In other words, personal rights are not guaranteed. While the Minister-President has general control of the affairs of state, as a matter of fact, however, military and naval officers are authorized to approach the Emperor direct upon affairs of state, and otherwise than through the medium of the Minister-

President, and obtain certain decisions thereon. Questions of military expansion and national defense which are closely related to affairs of state, diplomacy and finance, are really settled outside of the sphere of the Minister-President. The Board of Marshals and Admirals of the Fleet (Gensui-fu) and the Military Council (Gunji Sangi-in) afford special protection to the power of the military element. It is obligatory that the two Cabinet positions of Minister of War and Minister of the Navy, and other high administrative offices, shall be filled by military and naval officers of high rank. In its practical working, this means that the army and navy are able to dictate who shall be Minister of War and Minister of the Navy, respectively, and can use their power in such a way as to destroy any cabinet to which they may become opposed. In a book by the former Minister of Justice in the Okuma Cabinet, Mr. Ozaki Yukio, entitled "The Voice of Japanese Democracy," published in Yokohama in 1918, with an introduction by Marquis Okuma, it is stated that under the present system, military and naval men are empowered to assume any official position whatsoever in addition to those military duties which are properly attached to their profession—that is, they are qualified to be ministers or vice-ministers of education, finance, agriculture and commerce branches of the administration which are removed as far as possible from things military; while at the same time, civilians are absolutely disqualified for the posts of ministers and vice-ministers of war and the navy, and the Governor-General of Korea, Formosa or Kwantung. In the civil service, officials, other than ministers of state, who are personally appointed by the Emperor, are so few in number that they can be counted on the fingers of both hands; but in the military service there are several scores of such, including governors-general of various colonies, commanders of divisions, commanders of naval stations, etc.

Another writer, Mr. Walter W. McLaren, in an article on "Present-Day Government in Japan," which appeared in *Asia* in March, 1919, says:

When coupled with the rules of the Privy Council adopted in 1894 prescribing the qualifications of candidates for certain high offices, among them the cabinet offices of the army and navy, it has been possible for the Supreme Military Council to control to a large extent the policy of the cabinet. An example may serve to make this matter clear. In December,

1912, the second Saionji cabinet resigned while it enjoyed the support of the majority of the membrs of the lower house of the Diet. The cause of the downfall of the ministry was the defection from its ranks of the Minister of War, General Uyehara, whose resignation came about as a consequence of the refusal of the cabinet to adopt as part of its legislative program for the year an army measure providing for the creation of two new divisions. Uyehara exercised his right to resign, but the Supreme Military Council made the ministry pay the penalty by refusing to detail a qualified officer to take his place, and if the army will not fill the war office in any cabinet, of necessity the minister-president and his colleagues must resign.

The checks exercised by the law-making branch of the administrative department in most constitutional governments are not found in the Japanese system. How far the Japanese Lower House may resist the exercise of arbitrary power from above is difficult to determine, but the refusal to approve a budget may bring on a political crisis, resulting in the downfall of the Cabinet. Under the law, however, the budget of the previous year will remain effective, so that the government may nevertheless continue to have financial support.

As stated previously in regard to the city of Tokyo, only about one in one hundred of the population exercises the right to vote. A great many people do not vote on account of the property qualifications involving also the payment of taxes. At any rate, there is not universal suffrage in Japan. The Cabinet is not responsible as a whole for the acts of individual members; neither are ministers responsible for the acts of the Cabinet as a whole. It therefore follows that the best hope of the people of Japan lies in the *parliamentary* form of government instead of the *presidential.*

CHINA

It is interesting to note that the Provisional Constitution of the Republic of China, adopted at Nanking in 1912, usually referred to as the "Old Constitution," follows the general type of North, Central, and South American republican constitutions, but the "Amended Provisional Constitution" promulgated at Peking on May 1, 1914, resembles in many respects the Japanese Constitution with many modern innovations. The struggle between the partisans of the two may be said to at least contribute to the education of the advocates in the much neglected subject of constitutional law.

CONCLUSION

Modern governments recognize the principle of popular consent and the consequent necessity of having the will of the people ascertained through elected representatives. The representative, however, is not specifically instructed by his electors as to how he shall vote on all questions although he may be elected to represent a special issue but, in practice, he judges questions not only in the interests of his own constituents, but mainly in the light of the needs of the entire community for whose benefit the laws are enacted. The tendency is, however, unfortunately towards courting local favor to insure re-election, and towards combining with others, or what is known as "log-rolling," to secure special local advantages to the pleasure of the local community but to the detriment of the national interests. Debates, or "speeches," in legislative bodies are too often more largely directed to constituents than towards influencing the views of the other members who are supposed to be listening, but, on the other hand, *the efficiency of democratic government depends upon the thoroughness with which every one is willing to test his judgment and opinions in free and open discussion.* Discussions of measures in committees of Congress are too often made behind closed doors, although it is growing to be the custom to take stenographic notes and subsequently publish the proceedings.

It is not easy for a representative to free himself from local interests in order to represent purely national matters, but this at least differentiates a statesman from a politician. We are becoming, in America, more impatient and more accustomed to insisting that problems be met with solutions that bring tangible results, and what is really needed is a business administration by business men accustomed to achieve results by business methods. These standards prevail very strictly in the United States Navy, but no previous training and no examination for fitness is necessary for a minister or an ambassador of the United States to a foreign country, or of a cabinet minister or other appointee to office, other than the ability to be confirmed by the Senate. The re-organization of our diplomatic corps in the matter of appointments and fitness is quite as necessary in relation to the country's efficiency in war as that the form of government should be fit. We pay our cabinet officers and diplomats too little, but we also exact too little in responsible administrative results.

Modern government tends away from *aristocratic, hereditary, immediate,* and *unlimited* government, and towards a *centralized* form of government which is mildly despotic in military affairs, but with responsibility definitely fixed by a responsible and responsive individual or body. There has been a progressive tendency to make the basis of representation exclusive of all adult citizens, and, in some countries, of all adult women as well as men. The original theory of representation was not democratic and was based rather on experience, education, and property-holding. It cannot be said that these restrictions have produced entirely satisfactory results, but universal suffrage is at least impracticable without universal education. Communities, and not individual voters, are represented in the United States Senate, and several small states have only one Congressman and yet have the same number of Senators as the largest and most populous states. In some countries chambers of commerce, the church, educational institutions, and communes are allowed certain representatives. The British House of Commons, as its name signifies, was originally composed of the representatives of communal bodies. The "Mother of Parliaments" developed in England through the summoning to London of representatives of the different communes and classes of citizens to come to an understanding with the crown on the question of taxation and later of administration.

In general, we have seen that the English Government and our government stand at the two extremes of constitutional government with neither country ever prepared for war, but the former German Empire, which the world denounced as an autocracy, was mild as compared with the form of the Government of Japan. Unquestionably, the Japanese Government is the most efficient for war purposes. The British Government is effective to the extent that it is *immediate*. The French Government is effective largely through conscription, but is weak in continuity of policy, and she has constantly been placed in jeopardy by the frequent changes in ministries. Our government may be made effective by divorcing politics from military and international questions, and thus placing the national safety over the exigencies of party politics.

We have seen in each country how constitutions may be modified, and we have seen the many differences between the theoretical and the real government. The great defect in our own government is the absence of definite legislative responsibility. A Con-

gress elected in November does not come in until the following March, and often not until the following December, when the platform on which it was elected has been forgotten. When it does come in it turns the work of legislation over to committees nearly equally divided as to membership between the party in power and the minority. Congress is apt to accept the report of a committee as the verdict of a jury. Work in a committee is naturally not publicly conducted; discussion is more or less limited; there is no definite responsibility; and the time devoted to discussion of a bill in full session of Congress is limited. As, however, bills are considered in both the House and in the Senate, many ill considered and objectionable bills fail in one branch which have passed in the other. For all that, many bills which pass Congress do not receive adequate consideration and, as no member is permitted to allude in the House to anything which has taken place in the committee, log-rolling is made very easy. A single committee should control all revenue and all lump sum appropriation bills, *so that the party in power is responsible.* This implies practically a form of budget system, with committees of Congress interested in detailed expenditures under the different departments and their bureaus.

One of the dangers of the cabinet system to which we are not exposed is the establishment of a vicious circle of professional cabinet ministers who, while apparently opposed to each other in political principles, really take their turn in holding office, so that when one cabinet is overthrown the other comes in with a more or less complete understanding with the government which has just been ousted. This was the state of affairs in Portugal under the monarchy and is under suspicion in several other countries. There is no danger of our getting the parliamentary or cabinet form of government in our country, as the presidential is much more efficient and is strongly intrenched, but a revision of certain features of the Constitution of the United States would contribute to efficiency for war by more definitely fixing the responsibility upon individuals for failure to take proper measures in a given case or for taking measures which prove to be a failure. The right to vote should imply the obligation to bear arms or serve the state in times of national danger. The voluntary system of passing responsibility on to the shoulders of the willing should give place to universal military training and obligation.

As a result of the war some changes may be looked for in forms of government of the Great Powers, especially in regard to treaty-making and the right to declare war. This right must be surrendered to the respresentatives of the people, rather than have it rest in the sovereign or in the cabinet. Likewise, there must be responsibility to the people in guiding international relations. Our own treaty-making methods do not work smoothly at all times, but whatever difficulties we may seem to have, the right to declare war and to make treaties is in harmony with modern tendencies.

It is important to again repeat the pregnant words of Professor Albert Bushnell Hart, "Government does not rest ultimately in the consent of the governed, but on its conformity to the will of the world's spirit, which makes and unmakes civilization."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

WHAT IS THE MATTER WITH OPERATING ENGINEERING?

THE QUESTION

By Lieut. Commander H. F. D. Davis, U. S. Navy

1. What is the matter with operating engineering?

2. This question is raised constantly by officers who have watched the development of engineering in the navy. It is held in the minds of all by comparison of the interest shown in operating engineering with the interest in gunnery, such comparison never being to the credit of engineering. It is brought forcibly to the front at the present time by the fact that the personnel situation is such that the navy must begin at the bottom and build up a structure almost entirely new.

From: Commanding officer
To: Commander battleship division. . . .
Subject: Operation engineering, lack of interest in.

1. It is believed it may safely be said that there has never been more competent commissioned engineering talent in the battleship force than is the case to-day. Considering the service of the battleship force, past and present, material engineering conditions are excellent. On the other hand, operating conditions are only fair, and the reason for it is due, it is believed, to the lack of organization for co-ordination in engineering similar to that which obtains on the squadron staffs, and particularly on the force staff, in connection with gunnery. The gunnery officers of the battleship force have the closest sort of liaison organization to the immense benefit of the gunnery work. Due to this intimate association of the gunnery officers, led and guided by the force gunnery officer, not only has each ship reached a position as far as records and data are concerned that at the end of each week the individual ship knows how she stands as far as efficiency is concerned, but the division and force commanders also know, and the other ships of the force, and if any unusual or unforeseen difficulties have been encountered in the other vessels of the force; and efficient standardization of methods and records is thereby determined. On the other hand, the efficiency of naval engineering has not improved in anything like the same degree, if at all, and there is vast room for improvement in operating engineering. This letter does not refer to designing engineering at all. Designing engineering will take care of itself if the policy recommended in this letter is carried out.

2. Gunnery officers and signal officers have frequent gatherings for the exchange of ideas and for mutual indoctrination. The supply officers sometimes have such meetings, and even the navigators meet occasionally, but so far this cruise there has been nothing of the kind for the engineers. It is one of the hopeful signs for progress, that whereas not so many years ago the engineers might have desired not to have a feeling of neglect, and somewhat of derogation, because of the apparent lack of interest on the part of the flag officers in the personnel of the heads of the engineering department of the ships of the battleship force.

3. But further than this, the gunnery officers are sought diligently, a list of officers possibly good material for the development of the gunnery officers is kept, and diligently scanned and revised. When once found they are watched closely, and the most excellent records of their performances, their characteristics and capabilities are kept and studied. This solicitude is due in great measure to the fact that our sole source of supply for gunnery officers lies in the naval service, whereas it is commonly accepted that an abundant supply of steam engineers can be obtained from civil life. It is true that engine drivers, and engineers of the grade of our warrant engineers, can be obtained in the case of necessity, practically without limit, but the experience of this war has shown that the high-grade engineer, such as those we have among the commissioned engineers of the naval service, is difficult to obtain from civil life, and when found, it takes not less than six months for him to orient himself sufficiently to begin to show ability in a practical form. It is believed to be a fact that nowhere is there a list kept of the available commissioned steam engineers of the service, with records of their performances, qualities, and characteristics, similar to that which obtains in the case of the gunnery engineers; nor will there be until the fleet begins to approximate the interest in the personnel of the engineer officers that now obtains in the case of the personnel of the gunnery officers. It is not too much to say that they are of equal importance.

4. It is desired to emphasize the fact that the staff engineer officer is primarily a personnel officer. Heretofore he has appeared to have been a material officer only. It is not desired to minimize the importance of the material duties of such an officer but it is desired that it be clearly understood that this officer is above all else a leader of men.

5. The lack of interest is not confined to the battleship force. The Bureau of Steam Engineering, the Bureau of Navigation, the Office of Operations, and the Office of Engineering Competitions are equally apparently lacking in interest in this regard, and if the principle of the policy above suggested meets with the approval of the division and force commanders, and of the commander-in-chief, it is suggested that this letter be forwarded to the Navy Department with appropriate comment.

6. It is recommended that an officer of appropriate rank be assigned to all force staffs, and that it shall be his duty to coordinate and direct the efforts of the engineer officers of the force with the mission to determine the highest possible standard of engineering efficiency in the force; particularly operating efficiency.

(Signed)............................

THE CONDITION OF ENGINEERING PERSONNEL

3. The conditions of enlisted personnel on January 1, 1920, are shown in the following table:

Branch	In service Jan. 1, 1920	Required for 143,000	Present shortage
Seaman branch	52,996	67,664	14,668
Artificer branch	7,013	11,765	4,752
Engine room force	23,789	41,311	17,522
Engineer force—all ratings	27,436	49,904	22,468
Special branch	7,054	10,600	3,546
Commissary	3,689	6,982	3,293
Messmen	7,139	4,835	2,304 excess
	101,680	143,157	41,477

From this table it is seen that the engineering personnel, including those artificer ratings, usually under the engineer officer of a ship, should be $\frac{49{,}904}{143{,}157} = 35$ per cent of the total; 33,282 of the 49,904 should be petty officer ratings. The actual shortage on January 1, 1920, in all the engineer ratings was 22,468. There were only 12,903 engineer petty officers instead of the 33,282 required and many of these 12,903 will probably soon leave the service unless conditions are radically changed for the better. These petty officers are the experienced men, the backbone of engineering personnel of the service, the men upon whom the service relies to train, by personal example and daily intimate association, the new and untrained recruits.

THE NEED FOR AN IMMEDIATE ANSWER

4. The answer to the question raised in this paper should be found and a proper remedy discovered for the trouble affecting operating engineering in order that the problem of building up the operating personnel may proceed more rapidly from a sure foundation and with a vital stimulus forcing officers and men on to better things. The guns of our ships are of no use unless they are put in the proper place and *kept there* by the operating engineers. The best brains in and out of the service are therefore to be enlisted to work on this problem in an effort to get the right answer.

5. It will also be seen from the above table that for a total strength of 143,000, 67,864 men are called for in the seaman branch; and the enlisted engineering personnel should be 73 per cent of this number viz: 49, 904 as stated.

6. Accordingly, in order that the men of the engineer force may be given the same amount of supervision during education and training as is given to men of the seaman branch in their gunnery training, there should be 73 per cent as many officers of equal ability, below heads of departments, assigned to engineering duty as are assigned to gunnery duty. Further, the Secretary of the Navy, the chief of naval operations, the bureaus of the department, the commanders-in-chief, the commanders of squadrons, the captain of each ship and the staff officers of each ship should properly show the same interest in the officers and men of the operating engineer force that they manifest in the officers and men that fight the guns.

7. It is not believed that anyone will dispute the fact that such interest is not now shown. What captain of a ship shows the same interest in the selection of his engineer officers that he shows in the selection of his gunnery officers? What commander-in-chief shows the same interest in the work of his fleet engineer officer as in the work of his fleet ordnance officer? How does the care with which an engineer officer is selected for a ship in the Bureau of Navigation compare with the consideration given the selection of the ordnance officer of a ship?

8. In this connection a study of proposed legislation now being considered by Congress reveals the important fact that extra compensation is to be provided for men to stimulate interest in gunnery, in clerical work, and in commissary work. No mention is made of similar rewards to stimulate interest in engineering!

9. An attempt will be made to show that there are definite reasons for this state of affairs; and the kind of remedy needed will be pointed out.

THE INTEREST IN GUNNERY

10. The care of guns, turrets and ordnance material in general is a relatively simple operation directly comparable to "cleaning stations" in the engineer department and elsewhere in the ship. The preparation for action of guns is a relatively simple and short operation. The active life of a gun, assuming it to be 1000 rounds, is less than as many seconds. During this short time it gets or fails to get all the results that are expected of it.

11. Standardization in ordnance has progressed to a relatively great extent and the quality and characteristics of guns of similar size and design are remarkably uniform.

12. The productive life of a naval gun is divided into periods during which five to ten shots are fired. By the target practice methods developed to date, the results of each period can be definitely computed in hits per gun per minute. This measure of efficiency is direct and easily arrived at. It becomes a part of the records of the men in the gun's crew, of the battery or turret officers concerned, of the gunnery officer, of the Executive and of the Captain. Each of them is, therefore, intensely interested in making as high as possible the "hits per gun per minute" of each of the guns which affects his record.

13. In the active training of guns crews and the units that make up the gunnery organization of a ship the conditions of target practice and actual service of the gun can be and are very closely simulated. Records of the hits per gun per minute can be and are made a part of the daily drills and thus give continuously a direct means of comparison between guns crews, divisions, ships, and larger units of the fleet.

14. A better plan for stimulating interest of all concerned can hardly be conceived. The "hits per gun per minute" make the lever by which gunnery has been raised to its present level of excellence, and the lever which in the hands of interested officers will serve to force progress hereafter.

THE LACK OF INTEREST IN ENGINEERING

15. The productive life of a machine is quite unlike that of a gun. The nearer to 100 per cent of its actual life that can be made productive the better the machine. The cleaning of a machine is a minor, although necessary, part of its life. The repairs to the machine are more or less frequent depending on the conditions of operation. During operation it requires constant attention such as lubrication, adjustment of speed and load, increase of, or decrease of, input, of temperature, etc.

16. Although the engineering material of our ships is uniformly good, standardization in engineering has proceeded to a less degree and the excellence of similar machines on different ships varies in very marked degree.

17. There has not been developed, nor is there in immediate prospect a definite measure of the productiveness of a machine in terms similar to hits per gun per minute. We have not yet developed a convenient, easily understood, easily arrived at measure of efficient performance for each machine. There is no

measure of results of productiveness which becomes an immediate part of the record of the men responsible for the operation of the machine, the supervisory officers concerned, the engineer officer, the executive and the captain. The methods of operation usually shift, partially or completely, the immediate responsibility for proper operation of a given machine each time a watch changes, *i. e.*, every four hours. In consequence, there is no stimulating vital interest in the men or the supervisory officers, extending through the engineer officer and the executive to the captain. In this fundamental point lies the trouble with operating engineering. The engineering competition fails, and has failed, because it does nothing to give a vital interest extending from the man with the shovel or the oil can through the supervisory officers and the captain to the commander-in-chief and to the Navy Department itself. There is now no lever of like value to "hits per gun per minute" which can be put in the hands of interested officers to raise the standards in operating engineering and upon which to base rewards; assuming that proper rewards are forthcoming.

CONCLUSION

18. In propounding the question "What is the matter with operating engineering" and in explaining the lack of vital interest in engineering, a parallel has been drawn with gunnery and gunnery methods.

19. It is not intended to indicate thereby that the vital interest giving element that it sought for engineering can be furnished by the methods developed for gunnery. In view of the great differences indicated above, it is believed that it may be found in a very different way. The finding of this method of stimulating interest in engineering appears to be largely a psychological problem which must have a practical solution found by the navy for itself. The trained psychologist, however, should be able to give valuable assistance.

20. It is confidently believed that a solution of this problem can be found and that, when found, operating engineering will rapidly advance, as it should, and remain thereafter the coequal partner in a growing success of our navy. Such solution cannot come without the careful thought, efforts, and cooperation of all officers who are interested in seeing our navy the leader of naval progress without a peer in all branches of naval endeavor.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A PROPOSED SYSTEM FOR STIMULATING INTEREST IN OPERATING ENGINEERING

By Lieut. Commander Frederick C. Sherman, U. S. Navy

The defects noted in connection with the interest in operating engineering in another paper in this issue of the Proceedings may be listed as follows:

(1) Lack of an accurate and convenient measure of efficiency of a machinery installation.

(2) Lack of interest in engineering by supervising officers and men.

(3) Lack of a proper competitive feature similar to competition in gunnery.

Further, it is stated that the problem is psychological and that engineering is not recognized in true proportion to its importance in getting the guns into position in battle. If the psychological problem can be solved and if the interest and brains of the personnel concerned are applied to operating engineering in the same measure that they are applied to gunnery, it is believed that operating engineering will advance in step with gunnery and will solve its own problems.

The present methods of engineering competition have outlived their usefulness and have failed to solve the problem for the following reasons:

(1) The competition is based on economy rather than efficiency. Economy is only one feature of efficiency and not even its most important one.

(2) The engineering competition is extended over such a long period that interest lags and, figuratively, the personnel go stale. No athlete would attempt to keep up to A-1 condition and run a race every day in the year.

(3) The present engineering competition sometimes puts a premium on delaying desirable repairs for as long a period as possible in order to save on economy.

(4) The present competition fosters discontent by encouraging the cutting down of fresh water supplies and electric lights and fans to such a point as to cause discomfort or inconvenience to the officers and crew. This fact causes some ships to take little interest in competition as they rightly consider contentment more important than a high place in the competition.

(5) The present competition has no spectacular features, with results immediately visible to everyone on the ship. Such a feature is infinitely more desirable than waiting on endless computations of figures which are usually not available until the end of the competition year, as with the present method of competition.

(6) There is no suitable method of reward for every member of the ship involved in the results achieved.

There may be other elements in the problem, but it is believed that the above comprise the principal reasons for the failure of the present method of engineering competition to achieve the results desired in operating engineering.

To correct the conditions a system of competition is believed necessary which will accord with the following specifications:

(1) It must create interest, rather than discontent, of all hands.

(2) It must not include any features which may result in the cutting down of adequate comforts for the crew throughout the whole year.

(3) It must *measure efficiency* rather than an economy which is liable to become niggardliness.

(4) It must be spectacular enough to arouse the interest of the entire ship's company from the captain down to the lowest seaman and to have results immediately visible to all.

(5) It must be intimately connected with gunnery in order to bring home to everyone the fact that battle efficiency depends both on operating engineering to place and keep the guns in position and on gunnery to hit when so placed.

The following system is proposed as designed to fill the above requirements:

A competition should be established for battle efficiency to comprise both engineering and gunnery features in the same

competition. Base this competition on the ability to place the guns in position and on the ability to hit with the guns after being so placed. In order to accomplish this, the knots per ton of fuel, best performance, should be established as a standard for each ship. Then figure out a standard number of miles to be steamed for the battle target practice. Assume this is adopted as 40 miles. Then assign to each ship for its battle efficiency practice, the exact amount of fuel required to steam 40 miles at the rate of its standard of knots per ton established from its best performance, and allowing for a certain period of full speed, say one hour and the balance at economical cruising speed. Umpires would be appointed to measure out the amount of fuel allowed and observe the operation of the ship. Then have the ship start its approach from a point accurately a certain distance, say 25 miles, from the target. Require the ship to steam at full speed for one hour at some time during the run (establish the full speed revolutions as a standard for each ship) and at its enconomical speed (discretion of each ship) during the rest of the run, proceeding all the time toward its target. Let it fire its guns if it gets into position and continue steaming until its allowance of fuel is expended and then stop. Its score for engineering would be its percentage of the established number of miles (based on revolution curve) obtained from its fuel allowed. In other words, a ship which steamed only 30 miles would get a score of 75 per cent. A ship which steamed 40 miles would get 100 per cent. If a ship exceeded its best performance and got more than 40 miles, it should be credited with a multiple correspondingly greater than 100. In connection with this competition, the starting points of the target and of the firing ship should be a definite distance apart and the course and speed of the target should be unknown, although to make the competition even, the component speed of the target along the base course should be the same for all vessels of a class. In addition to steam used in main propelling plant, the ship should be required to run all the auxiliaries required for battle and to make a certain quantity of fresh water depending on the evaporating plant installed.

Under this competition, if the ship failed to reach the firing point before her fuel allowance was expended, she would have to stop and would not even get a chance to fire her guns. Of course she could be allowed to fire her guns in a separate run for training purposes but such firing would not count in the competition.

Then I would recommend that the entire prize money be divided among the whole ship's company somewhat on the share system as established in the old days of prize money for capturing valuable merchantmen. Allow a battle efficiency prize to the ship standing one of $10 per share. Give all non-rated men on the ship 1 share, third-class petty officers 1½ shares, second-class petty officers 2 shares, first-class petty officers 2½ shares and chief petty officers 3 shares. For the ship standing two, the same system would be followed except the value per share should be $5 and for the ship standing three, the value per share would be $3. In addition, I would recommend that a letter of commendation be given to every officer, commissioned and warrant, attached to a ship to which a prize is warded for the enlisted men. The present system of picking out three or five officers for commendation is positively harmful in that it causes many heart burnings and jealousies, whereas it is frequently utterly impracticable to limit the list of officers contributing to the success of a ship to the three or five allowed. Every officer on a ship has more or less responsibility for the success of a ship, according to his rank and assignment to duty, and should partake in the rewards. To discriminate between them is not always easy and it is recommended that every officer on board be eligible for a letter of commendation, always provided, of course, that the commanding officer approves.

Extra pay should continue to be given to gun pointers who qualify but should also be given to those engineering ratings which are most important in operating engineering, subject to a qualification based on the ships performance in the competition.

This competition would furnish spectacular features in that every person on the ship would be interested and would see approximately how many miles the ship had steamed. Its score would be known immediately upon the completion of the run. And what a visible result would be apparent if a ship had to stop either before or during firing because she ran out of fuel! Or had a breakdown! It would be a most emphatic and visual reminder to all hands that battle efficiency depends both on operating engineering and on gunnery.

This system would also tend to unite the interests of both the deck force and the "black gang" in that both would depend on each other for prize money and would be personally interested in

the others' performance. It is believed that this system would tend to eliminate what is too often the case, friction between the engineer's force and the deck force.

This system also would not tend to create discontent as it would be unnecessary to shut down on quantity of fresh water issued or on electric lights or ventilation, during the rest of the year, as these things would cut no figure in the competition. But constant training to *get the most out of a pound of fuel* would be required in order to have competent personnel for the competition when it came. And in the last analysis, that is really what is to be sought after. In addition it would require constant attention to the condition of material in order to train the personnel to get the best results. This feature could be stimulated in addition by causing the time when the competition would be held to be unknown to the ships, within a reasonable notice.

This competition would resemble that of an athlete training for a race. His supreme trial or test would come only occasionally, but for him to make a showing in that test would require his constant training and preparing himself to be in condition for the race when it came.

Many details of such a competition would have to be worked out further than outlined above. The principal features should be those given. It might be desirable to have a primary engineering competition similar to short range target practice for the purpose of giving certain engineering ratings an opportunity to qualify for extra pay as mentioned previously. Such a primary competition could be similar to the one outlined above only restricted to one speed, either full speed or economical speed as desired.

To make this system of competition effective would require that the present engineering competition be abolished entirely and the suggested one substituted. Gunnery competition should be carried out as at present except that the present battle practice (long range gunnery practice) rules should be re-written to conform to the engineering requirements recommended herein. Short range target practice should be restricted to a practice to qualify gun pointers for extra compensation. Prize money for this practice should be eliminated and only awarded to the ship as a whole on its performance in the battle efficiency competition. A similar primary engineering practice might well be held to qualify lead-

ing engineering ratings for extra compensation, based on the ship reaching a certain standard of performance.

This suggested method of competition could be worked out in an infinite number of ways to apply it practically to the service. But the essential point is to have for the engineering competition basis, how far a ship can go on a given quantity of fuel, and for the test to be in connection with gunnery exercises. It can be applied to any class of vessel, of any kind of power plant. It makes a spectacular, sporting event which will arouse the interest of every one on the ship, and the results are immediately visible.

It is believed that a competition such as above would overcome the defects of the present system, would stimulate the interest of everyone on board ship, and would present a fair and equitable measure of the efficiency (as opposed to economy) of the engineering performances of all ships. Every man operating a piece of machinery would be personally interested in obtaining efficient results from the machine and as low consumption of power put in, compared to power obtained, as possible.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SHORT RANGE BATTLE PRACTICE FOR THE ENGINEERS OF THE NAVY

By COMMANDER H. R. GREENLEE, U. S. Navy

In other papers in this issue of the PROCEEDINGS, there appear discussions of reviving, creating and stimulating interest in engineering matters in the navy, particularly afloat and as affecting both officers and enlisted personnel.

To effect this for officers requires undoubtedly a different system than it does for men. The man has selected his work along engineering lines and wants to do that class of work but he frequently fails in getting the best results through his own personal characteristics, unfortunate assignment to station by the engineer officer, lack of proper training and hence lack of knowledge as to proper operating conditions, and how to make a machine operate economically. He may and probably will be perfectly satisfied if the machine operates without breaking down, but as for efficiency of this operation he has no measure and probably in most cases he will give it little, if any, thought. To improve his point of view, *i. e.*, to make him one of the firm, it is only necessary to measure the efficiency of his work and establish a suitable reward worked out on a competitive basis, affecting not only the individual but affecting the ships as a whole.

The problem of reviving, creating and stimulating interest in engineering among the officers is a different matter. Many officers forget the fact that they, each and every one, must be engineers first, last and all the time. This does not necessarily mean expert electricians or expert turbine operators or designers, but it does mean engineers in the broad terms of the meaning of the word, *i. e.*, "the science and art of directing the great sources of nature to the use and convenience of man." The major division of engineering used by the line officers of the navy are mechanical and electrical engineering, and no officer is fully quali-

fied to perform any duty afloat unless he is fully aware of the fact that he must have and then actually obtains a good general knowledge of engineering as it pertains to the ship on which he is serving. It frequently happens that an officer believes that he can follow a naval career "on deck" with no experience with the "engineers" and thus better fit himself for executive command, *i. e.*, the commander-in-chief of the most important fleet. The fallacy of this is that the individual overlooks the fact that matériel, personnel and operations of ships and fleets go hand in hand; that an engineering education coupled with engineering experience below definitely establishes a habit of accurate, sequential thought, which coupled with a familiarity with matériel matters of the ship or of ships in general, will go farther than is ordinarily believed toward fitting one for executive command.

Officers frequently shun engineering duty afloat for they know that unless they are to become permanent engineers, they must give it up upon reaching the rank of commander and that, if they have had a preponderance of engineering duty, they may fail in being selected for promotion, and that, at any rate, they feel that they are out of touch with deck work and therefore will not be prepared to go as executive officer of a ship or in command of a smaller ship. This, of course, may be true if the officer so elects, but the writer knows of officers who when engineer officer of a dreadnaught spent hours (which otherwise would have been leisure ones) around the bridge when underway, or on deck or discussing "top-side" methods and theories with the Captain, executive officer, gunnery officer and navigator, thus keeping in touch with the ship as a whole and preparing themselves for executive officer duty. It would indeed be unusual in such circumstances if an engineer never found opportunity to give some valuable suggestion to the deck people.

It is hoped that the law restricting the rank of engineer officers of ships to that of lieutenant commander and below will be amended to permit a continuance of this kind of duty by commanders at least.

A plan of requiring an officer to have had a certain definite amount of duty afloat as head of department before being selected for promotion would cure the fear of not being selected. That is, an officer should have a definite amount of duty as gunnery officer or engineer officer, and as first lieutenant or navigator. It

might be any one of the following four combinations: gunnery and navigator, gunnery and first lieutenant, engineer and navigator or engineer and first lieutenant.

It is believed that interest in engineering among officers will be revived, created or stimulated by the publishing by the department of a definite statement showing under what conditions of satisfactory general service and amount of duty of the various kinds that an officer must have, this to insure that he will not be hampered in preferment for promotion if he be disposed to follow engineering work.

It has been previously stated that the reviving or creation of interest in engineering, in the cases of the enlisted man, is not ordinarily necessary, for his interest and desire for knowledge does not, ordinarily, go beyond the engineering department. It is, however, frequently necessary to stimulate the man's interest. To stimulate his interest, the engineer officer and his assistants should study the man's personal characteristics and decide on the best method of handling him, for some men will act carefully and thoroughly on a suggestion, even endeavoring to forestall the issuance of definite instructions, whereas others will require a "cussing out" and the other men of the engineering department will be graded all the way between the two extremes. The end to be arrived at is to endeavor to get the work done, done willingly and at the same time boosting the job, the division officer, the engineer officer, the captain and the ship.

In the study of the individual to ascertain the correct method of handling him, and the final decision as to the method, his contentment and desire to accomplish will be stimulated by being bossed in the exact manner desired by him; now, if during this character study period, a decision be reached as to just the kind of duty for which the man is best fitted and along just what line he is striving and then assign him to it (there is, ordinarily, a niche somewhere on board ship into which each man can be happily fitted), a tremendous stimulation will have been administered.

One of the other papers states that it is impossible for an individual to apply himself with higher than average efficiency day in and day out without growing stale. This is true unfortunately and therefore, a periodic stimulus must be administered. In gunnery we have target practice. The gun or turret crew qualifies

for prize money and additional compensation on short range battle practice. In another paper, it has been recommended that the present method of figuring engineering competitions be discontinued and that long range battle practice be coupled with a full power and economical speed trial with full allowances for them and the ships score be a combination of the engineering and gunnery scores. It is believed that this is only proper, for, if the engineers cannot place the ship for the use of its guns then the value of the guns is reduced accordingly.

It is believed that there should be a competition in the engineering department on which to base awards of prize money and extra compensation corresponding in effect to short range battle practice. The competitions might well be held semi-annually, thus periodically furnishing a stimulus to personnel to actually get all machinery in its most efficient physical condition and therefore its most efficient operating condition as well as to study the method of how to operate most efficiently.

Along this general line a competition was recently held in the destroyer force, Atlantic fleet, in evaporator operation and the scores were published giving the standing by ships and evaporator operators. The results of this test were very interesting, in spite of the fact that perhaps many of the operators were inexperienced, but this test would appear to show conclusively that operators of machinery and apparatus afloat are not generally well instructed in their duties nor are they themselves studying and working intelligently toward increasing operating efficiency. It is very probable that if another competitive test is held within two or three months, the results will be striking. Thus it is, that physical condition and operating efficiency of machinery can be materially improved by a demonstration of such condition or efficiency and further improved by a competitive demonstration of such conditions and efficiencies.

The engine, pump, boiler and other engineering machinery on board ship is designed to have a certain water rate, evaporative efficiency, etc., and upon completion, test of the new machinery develops a certain efficiency which is established as the standard for that piece of machinery. A test of the individual machine at some subsequent time will determine its relative efficiency. Would it be a stimulant to a machinist's mate to know that if his pumps or his generators operated on test to say ninety-five (95%) per

cent of the standard efficiency that he would have five ($5) dollars per month added to his pay for the succeeding six months or that Tom Smith on the sister ship in charge of the same machinery only obtained ninety (90%) per cent efficiency on his pumps or generators? What efforts would be made to keep his pump water end valves tight, his piston rings and plunger packing in good condition, his steam valve mechanism in working order, the stroke of the pump properly adjusted? What thought would the machinist's mate give to getting or keeping the pump in perfect condition, what amount of study would he make of the details of the pump?

If the thought, study of and work on the pump were extended to all enginering machinery on the ship coupled with the stimulus of knowledge of the approach of the efficiency test and the desire to obtain the addition of a definite sum of money to his pay what would be the effect on the enginering efficiency of the ship, the fleet and the navy, and hence the efficiency of the whole navy? It would mean that the machinery of the navy was being operated by a force of thinking men, each striving to excel with semi-annual outbursts of enthusiasm causing increased thought, extra study and work with perhaps a falling back in efficiency subsequent to passing the peak of the tests, but never reverting even to the standard of efficiency that existed prior to the test. The effect would be marked. There would be less navy yard work to be performed with the incident expenditures of funds reduced, the operating cost of ships, in fuel, water and oils, would be reduced, the steaming radius of ships increased and the vessels of the fleet better fitted for the supreme moment than could be effected in any other manner!

The cost of the additional pay and prize money would be almost nothing as compared to the immense saving that would be netted to the government, in expenditures for repairs and extra fuel, etc. In fact the additional advantage of a force of harder thinking and more resourceful men plus the additional steaming radius and reliability of each ship would have a sufficient military value to discount all thought of cost.

The task of planning, preparing for and holding the proposed efficiency tests is acknowleged to be a large one but the difficulties are not unsurmountable, in fact no additional apparatus to that now on board each ship is considered necessary, other than some

means of actually measuring the total water used (not make up feed water) in driving the ship at designated speeds, necessary deductions being made therefrom, to obtain the water rate of the main engines, all other tests may be made at anchor.

It is, indeed, unfortunate that to date satisfactory steam flow meters have not been devised for marine use; however, there is nothing new in making efficiency tests of machinery with such apparatus as is now in the main, provided, for various individuals have on their own initiative been engaged in such investigations of heat losses for many years.

The purpose of this paper is to propose and discuss in general terms, the scheme of holding periodic efficiency tests of machinery with its attendant rewards to officers and men, this system with the proposals made elsewhere in this issue of the institute to supplant the present system of engineering competitions and thereby to establish a competition directly productive of real efficiency entirely through the education of the operating force into a thinking, working, boosting bunch of men.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NIGHT SCOUTING WITH LISTENING DEVICES

By Lieut. Commander Holloway H. Frost, U. S. Navy

All methods of scouting in use to-day rely upon the actual sighting of the enemy ships. This fact makes it practically impossible to scout during night or while in a fog. The chances for a successful search are also considerably reduced by the haze or mist which frequently reduces the visibility to five or even two or three miles. When darkness comes on, when fog is encountered or when the visibility is so decreased by mist that the area between any two ships on the scouting line cannot be covered, not only must the scouting line cease its advance, but it must retire at the assumed speed of the enemy. The fact that we can scout but 12 hours in 24 on the average in itself reduces the efficiency of the search by one-half. In addition to this, heavy fogs are very frequent off the North Atlantic and the Pacific Coasts of the United States, and in the North Atlantic misty weather prevails almost continually. The difficulty of scouting off the North Atlantic Coast was one of the most important facts demonstrated by the fleet maneuvers held in August, 1916; for a period of four days the visibility varied from four to eight miles and efficient scouting operations by the defending force were consequently impossible.

A typical search by the out and in method is shown in Fig. 1. At daylight a line of six scouts spaced at 40 miles is in position *AF*. During the daylight period of 12 hours it advances at the speed of 20 knots a distance of 240 miles to a position *A'F'*. Then, as scouting during darkness with the vessels spaced at 40 miles is impossible, the line must retire at 10 knots, the assumed speed of the enemy, for 12 hours. By daylight a retirement of 120 miles has been completed and the line is in position *A"F"*. During the entire period of 24 hours only 120 miles have been made good to the front, although 360 miles have been steamed at the average

speed of 15 knots. Fuel expenditure is a very important factor in scouting operations and if only 120 miles can be gained by 360 miles of steaming, the scouting force cannot expect to accomplish very much before it must return to its base to replenish its fuel supply.

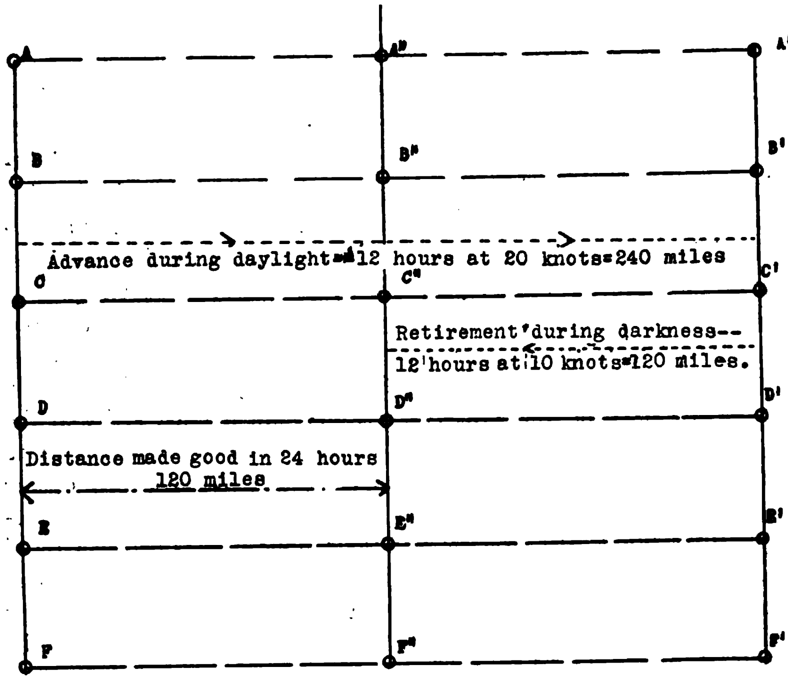


FIG. 1.—Out and In Method.

Assumed Speed of Enemy = 10.
Distance Steamed by Scouts in 24 Hours = 360.
Average Speed of Scouts = 15.
Distance Made Good in 24 Hours = 120.

It is apparent that the greatest advantages would be gained if some method of search could be developed so that scouting could be continued during darkness or fog in the same manner as it is carried on during fine weather in daylight. A possible way of continuing the search would be to use for locating enemy ships the listening devices developed for the anti-submarine warfare.

Rear Admiral E. A. Anderson, U. S. Navy, commanding the American Patrol Detachment, was the first to develop and test out the idea of using listening devices for scouting. As com-

mander of the submarine chaser squadron attached to his command I assisted in the development of this idea. The 12 chasers of the Squadron were exercised continually in listening for surface craft. It was made the normal procedure for chasers proceeding on an exercise cruise to form a scouting line at distances of about 10 miles for the purpose of conducting a night search for the numerous merchant vessels which are continually passing through the Florida Straits. After the scouting line was formed it was the doctrine for chasers to stop for the first 15 minutes of each hour for listening. The K-tube was put over in about 5 minutes; a listening period of about 8 minutes was then allowed; and the tube was hauled aboard in about 2 minutes. If there was reason to believe that vessels were within about 5 miles, the SC and MB tubes, which are fitted in the hull and can be lowered in a few seconds, were also used. For the remaining 45 minutes of the hour the chasers proceeded at 12 knots. A special code was issued for reporting bearings, for informing the squadron commander of the action taken by individual chasers and divisions, and for allowing the squadron and division commanders to give instructions for the scouting line.

In general the actual results obtained in these exercises were not so satisfactory as to prove that an efficient search can be made during darkness with the present design of K-tube. Sometimes bearings accurate to within five degrees were obtained of surface craft distant from 12 to 14 miles; in other cases vessels only 5 miles distant could not be heard.

The operation of listening devices is a very delicate process. Wide variations must be expected in the results obtained. In the first place the skill of the listener is a very important factor and a great amount of experience is necessary if the devices are to be used with real effect. An experienced listener will hear a vessel two or three times farther away than will one who has had only a short training. Also the skill of a listener varies on different days. On one day he will hear a vessel at 8 miles; the next day he will fail to hear the same vessel at 4 miles under the same conditions. The tubes themselves are delicate and no two will have the same degree of sensitiveness. They are also liable to go completely out of commission at any time. The degree of roughness of the sea has a considerable effect upon listening, and even when the sea is calm and when conditions are apparently the

same there seem to be important differences in the distances which can be heard, perhaps due to currents or eddies in the water, differences in temperature, the conformation of the bottom, or the depth of water.

Night scouting with listening devices will hardly be successful until it is possible to detect surface craft with a reasonable degree of certainty at a distance of 15 miles even under bad conditions. Possibly there are devices now which will accomplish this when skillfully used; if not, there is no reason why they cannot be developed. Since the signing of the armistice interest in the development of listening devices has waned; they were designed for use against submarines and now that the submarine campaign is over little attention has been given to them. It is true that another submarine campaign on commerce, such as was carried on by the Germans, will probably never be repeated in the future. But still the submarine will play an important part even if it is limited to attacks on men-of-war. This is well shown by what happened when the Grand Fleet was drawn into the submarine trap of 19 August, 1916. At least 14 torpedoes were sighted by British ships. The *Falmouth* was hit by four torpedoes and the *Nottingham* by three; both ships being lost. There were no less than 22 reports of submarines being sighted. The British submarine *E-23* torpedoed the *Westfalen;* the ship, however, succeeded in making port.

But while we will always need listening devices for use against submarines, they have a far wider field open to them in scouting, reconnoitering, screening and in making destroyer attacks. In order to stimulate the material development of the listening devices, it is proposed to show the advantages which can be gained by their use in night scouting. In order to show how they may be used when once developed, the detailed methods of night search which may be employed will be set forth.

While there are many forms of scouting operations, in nearly every case some form of the out and in method or of the retiring search patrol are used. We will therefore see how listening devices can be used in these forms of search. For the purpose of discussion let us assume that the listening devices are effective at a distance of 15 miles. It is not pretended that there is any distance at which you can always hear a vessel any more than there is a distance at which you can always see one. But in

solving a scouting problem it is necessary to make certain assumptions. In order to be able to assume a listening range of 15 miles, we would want to be certain that the devices would be effective at that range about 8 times in 10 under all weather conditions. Then, when you consider that the chances are very small that an enemy vessel will pass exactly midway between two scouts and that even then two scouts would have to miss it for it to pass through undetected, we could consider the scouting operation 95 per cent efficient and feel that in giving the enemy 1 chance in 20 to get through we would be taking a perfectly legitimate risk. In the sketches of the scouting operations, we invariably assume that the enemy is making a long cruise and is proceeding at 10 knots. In the tables, however, the figures for enemy speeds of 12 and 14 knots are given.

Now let us take up the out and in method. Assume that at sunset a scouting line arrives at the position *A'F'* in Fig. 1. Instead of retiring during the night, we desire to advance the line still farther to the front or at least to maintain it in this position. If the scouts are spaced at 30 miles, they can lie dead in the water during the entire night and by constantly listening for the enemy maintain their position without expenditure of fuel. If they are spaced at more than 30 miles, each scout must cruise back and forth along the scouting line, in a way which will be described later, if the line is to be maintained. If the scouting distance is less than 30 miles, then the scouts can advance the line to the front either by proceeding on constant courses or by steering a zigzag. The efficiency of the night search therefore depends to a very great extent upon the scouting distance. It will be shown later that, while favorable results will be gained if the scouting distance is less than 30 miles, the solution is not so satisfactory for distances over 30 miles. This at first might appear to be a very important disadvantage. In order to clearly define the situation, it will be well to see what scouting distance can be used in out and in scouting in actual war or maneuvers with actual ships.

At the War College it is assumed that single ships can be seen at a distance of 14 miles and that the smoke of formations of more than eight ships can be seen at 25 miles. In clear weather it is probable that single ships can be seen at 14 miles. The assumption that a formation of ships can be discovered at a dis-

tance of 25 miles depends upon the fact that a large number of ships creates a great mass of smoke which can be seen long before the ships themselves can be seen. Even with coal burners it seems rather doubtful that formations of ships can be seen at the distance assumed even if the weather is perfect. With oil burners—which will run smokeless in order to prevent detection—it would seem that 20 miles would be about the maximum distance at which the sighting of a formation of ships could be counted on. Therefore, for reasons of visibility alone, 40 miles seems the maximum distance at which scouts should be placed even in perfect weather. When it is considered that, except in tropical waters, there are comparatively few days of perfect weather, 30 miles would seem the usual scouting distance and this would frequently be reduced to 25 or even 20 miles. It will seldom be desirable to use a scouting distance just double the distance of visibility; a commander of a scouting line will always wish to have a factor of safety on his side; ships may break down, especially if run at high speed, radio communication may fail, vessels may be sunk or driven out of position by the enemy, and may lose their assigned position on account of unavoidable errors in navigation. Thus, excepting the length of line covered, every advantage is on the side of the closely spaced scouting line. There is more chance of sighting enemy ships, radio communication is better—thus increasing the rapidity with which reports of contacts can be made to the scouting line commander and the readiness with which he can maneuver the line—vessels attacked by superior forces can receive assistance quicker from adjacent ships, more reports of enemy forces encountered will be made—thus fixing the position of enemy screens from which an estimate of the position of the enemy main body can be made—and a force of ships from the scouting line can be concentrated quicker for an attack upon enemy scouts or a thrust through their line into the probable position of the enemy main body. For all of these reasons the scouting distance should usually be kept below 30 miles. For such distances the search can be continued during the night almost as efficiently as during daylight when our listening devices are effective at a distance of 15 miles.

If the scouting distance is just 30 miles the scouts can maintain their position dead in the water during the night, so that for the total period of 24 hours and advance of 240 miles will be made

at an average speed of 10 knots In the usual out and in methods the advance was but 120 miles for an average speed of 15 knots.

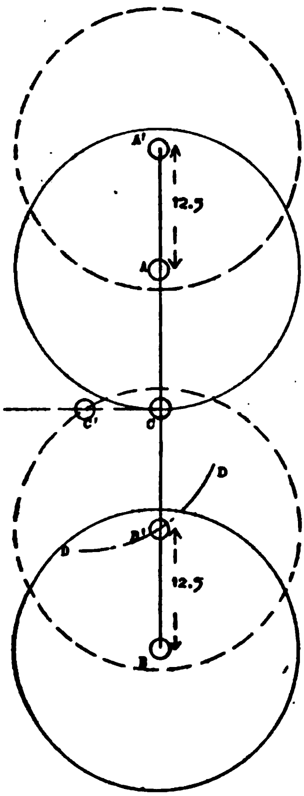


FIG. 2.—Maintaining the Line.

Assumed Speed of Enemy = 10.
Average Speed of Scouts = 12.5.
Running Speed of Scouts = 16.6.

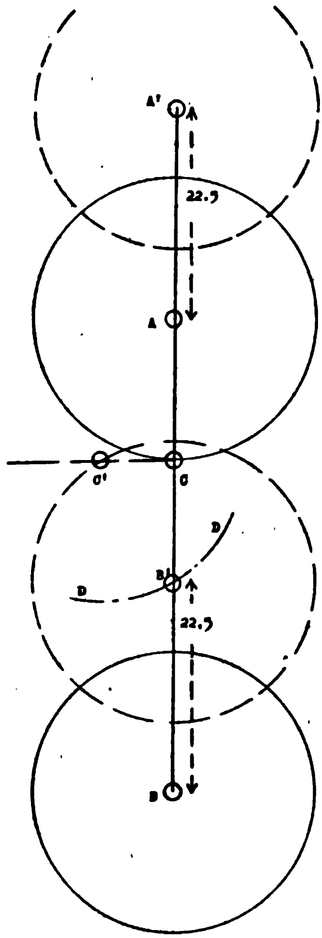


FIG. 3.—Maintaining the Line.

Assumed Speed of Enemy = 10.
Average Speed of Scouts = 22.5.
Running Speed of Scouts = 30.

Next assume that the scouting distance is 40 miles. In Fig. 2 two ships are at *A* and *B* distant 40 miles. After listening for

15 minutes in these positions, they proceed North to positions A' and B' in the remaining 45 minutes of the hour. Then after listening for 15 minutes they proceed South for 45 minutes to their original positions. This procedure is continued during the night and the scouting line is maintained. Assume that the ships are in positions A and B at the instant of getting under way on course North. The most favorable position for an enemy ship attempting to pass through the line undetected is at C, on the edge of the listening circle of the ship at A. In 45 minutes the enemy ship can run at the speed of 10 knots a distance of 7.5 miles to a position C'. With C' as a center and a radius equal to 15 miles draw an arc DD, cutting the line AB at B'. Therefore the scout which was originally at B must reach B' after a run of 45 minutes if the enemy ship is to be detected. $BB' = 12.5$ miles $=$ the average speed of the scouts per hour during the night. As the scouts must make this distance in 45 minutes their actual running speed will be 16.6 knots.

In Fig. 3 the scouting distance is 50 miles. The distance BB' in this case is 22.5 miles. The running speed of the scouts is therefore 30 knots. As it will be practically impossible to maintain this speed on the scouting line, this method of maintaining the line will be unsatisfactory when the scouting distance is as great as 50 miles. Such a distance, however, will be exceptional for daylight scouting. In case it is used during daylight it will be necessary to decrease it to about 40 miles at sunset.

The following table shows the average and running speeds of scouts necessary for maintaining the line for various scouting distances and for various assumed speeds for the enemy:

TABLE 1

Assumed speed of enemy	Scouting distance	Average speed of scouts	Running speed
10	35	7.5	10.0
10	40	12.5	16.6
10	45	17.5	23.3
10	50	22.5	30.0
12	35	8.5	11.3
12	40	13.5	18.0
12	45	18.5	24.6
12	50	23.5	31.3
14	35	10.5	14.0
14	40	15.5	20.7
14	45	20.5	27.3
14	50	25.5	34.0

Now let us consider cases where the scouting distance is less than 30 miles and the scouting line can be advanced. In Fig. 4 assume that two scouts are at *A* and *B*—distant 20 miles—at the end of a listening period. The most favorable position for an enemy ship attempting to pass through the line is at *C*. In 45 minutes this vessel can run 7.5 knots at 10 knots speed to the posi-

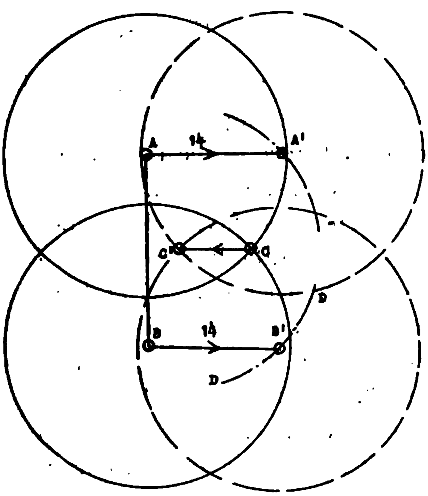


FIG. 4.—Advancing the Line.
Assumed Speed of Enemy = 10.
Average Speed of Scouts = 14.
Running Speed of Scouts = 18.6.

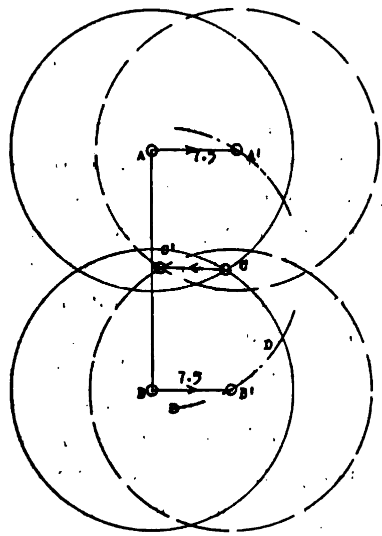


FIG. 5.—Advancing the Line.
Assumed Speed of Enemy = 10.
Average Speed of Scouts = 7.5.
Running Speed of Scouts = 10.

tion C'. From C' draw the arc *DD* with a radius equal to 15 miles cutting *BB'* at *B'*. The ships at *A* and *B* can therefore advance 14 miles to *A'* and *B'* during the running period of 45 minutes. The average speed of advance is therefore 14 knots per hour and the running speed will be 14 x 4/3 = 18.8.

In Fig. 5 the scouting distance is 25 miles, the average speed of advance is 7.5 and the running speed is 10.

The following table shows the average speed of advance and the running speed of the scouts for various speeds of the enemy and various scouting distances:

TABLE 2

Assumed speed of enemy	Scouting distance	Average speed of advance	Running speed
10	20	14.0	18.6
10	25	7.5	10.0
12	20	12.0	16.0
12	25	6.0	8.0
14	20	10.5	14.0
14	25	4.0	5.3

In advancing the line as shown in Fig. 5 the scouts proceeded on a constant course. If the scouts steer a zigzag, changing course after each listening period, a greater advance to the front can be made. In Fig. 6 three scouts at 20 miles distance are at *A, B* and *C* at the end of a listening period. The most favorable positions for enemy ships attempting to pass through the line are *D* and *E*. In 45 minutes' steaming at 10 knots the enemy vessel at *D* can advance to *D′*. With *D′* as a center draw an arc *FF* with a radius equal to 15 miles. This cuts *BB′*—the course of the scout 30° to the left of the base course—at *B′*. At the end of the running period the three scouts will be on the line *A′B′C′*. It will be noted that all points on the arc *D′E′* are within the listening circles drawn from *B′* and *C′*, so that no enemy vessel could have passed through undetected. The average speed of the scouts per hour (*BB′*) is 21 knots. Their running speed is 28 knots. The average speed of advance—the distance between the line *AC* and the line *A′C′*—is 18.4 knots. After listening for 15 minutes at *A′B′C′* the scouts proceed on a course 30° to the right of the base course to *A″B″C″*. When a zig-zag is steered a greater advance can be made to the front (18.4) than when constant courses are steered (14). However, the average speed of the scouts is 21 against 14 and the running speed is 28 against 18.6, thus showing that it is a far less economical method of search. There will, however, be cases where the rapidity of advance is more important than economy and then the zigzag search will be used.

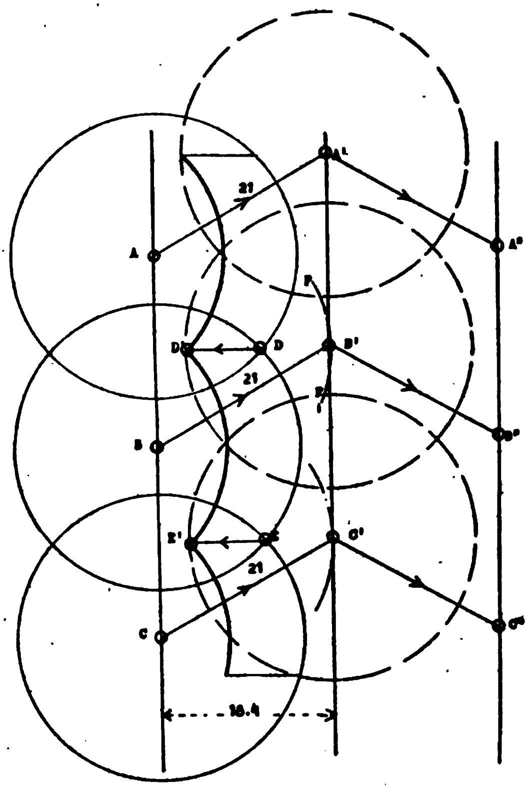


FIG. 6.—Advancing the Line by Zigzag Search.

Zigzag 30° from Base Course.
Assumed Speed of Enemy = 10.
Average Speed of Scouts = 21.
Running Speed of Scouts = 28.
Average Speed to the Front = 18.4.

The following table shows the running speed, the average speed of scouts and the speed of advance of a 30° zigzag for various speeds of the enemy and various scouting distances:

TABLE 3

Assumed speed of enemy	Scouting distance	Average speed of scouts	Running speed of scouts	Speed of advance of the line
10	20	21	28	18.4
10	25	18	24	15.5
12	20	19	25.3	16.7
12	25	16	21.3	13.5
14	20	17.5	23.3	15.4
14	25	13	17.3	11.5

In the Retiring Search Patrol the leading scout runs the retiring search for the assumed speed of the enemy; it is followed by other scouts at regular scouting distances. For determining the maximum distances at which scouts may be spaced and still prevent an enemy vessel from passing through undetected, the retiring search curve can be considered as a straight line without introducing an important error. In Fig. 7 a scout at the end of the first listening period is at *A*. Assuming that its average speed is 15 knots it will be at *A′* at the end of the second listening period. Assuming a speed of 10 knots for the enemy, *C* will be the most favorable position for a vessel attempting to break through the line undetected. Here it is on the edge of the listening circle drawn from *A* at the end of the first listening period; it advances in one hour 10 knots to *C′* on the edge of the listening circle drawn drom *A′*. At the end of the third listening period it will be at *C″*. At this time the first scout will be at *A″*, well out of listening range of the enemy vessel. In order to prevent the enemy vessel from passing through undetected the second scout must be at the end of its third listening period within 15 miles of *C″*, or at *B″*, the intersection of an arc drawn from *C″*, with a radius of 15 miles, with the line *AB*. If the second scout must be at *B″* during the third listening period, it must be at *B′* during the second period and at *B* during the first period. *AB*, the scouting distance, is 43 miles.

The following table shows the scouting distances for various speeds of the enemy and various average and running speeds of the scouts:

TABLE 4

Assumed speed of enemy	Average speed of scouts	Running speed	Scouting distance
10	15	20	43
10	18	24	46
10	21	28	49
12	15	20	42
12	18	24	44
12	21	28	46.5
14	15	20	37
14	18	24	39.5
14	21	28	41

In Fig. 8 there is shown an example of search by the Retiring Search Patrol Method. At 6 p.m. an enemy force was reported at *O*. Assuming a maximum speed of ten knots for the enemy

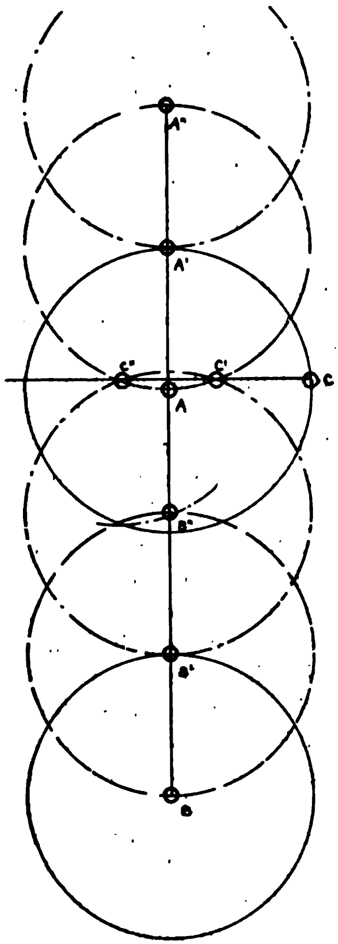


FIG. 7.—Patrol Method.
Average Speed of Scouts = 15.
Running Speed of Scouts = 20.
Scouting Distance = 43.

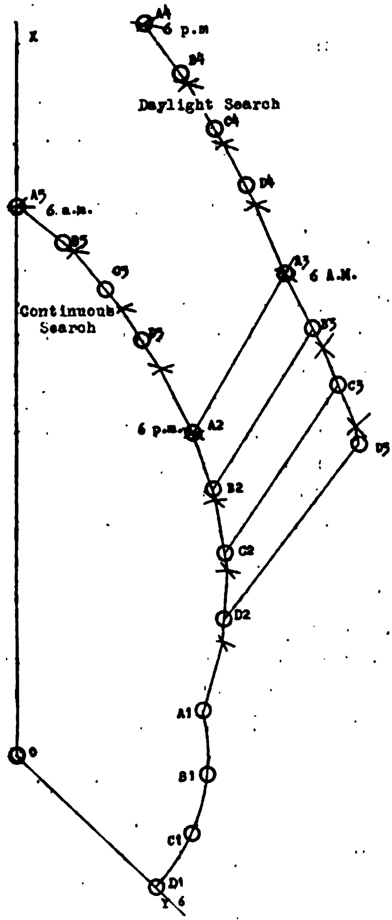


FIG. 8.—Comparison between Continuous Search and Daylight Search with the Retiring Search Patrol.
Scouting Distance = 40.
Average Speed for Continuous Search = 15.
Average Speed for Daylight Search = 13.3.

it is required to search the sector *XOY*. At 6 a. m. the next morning four scouts spaced at 40 miles are in position on the arc *A1-D1*, drawn with a radius of 120 miles from *O* as a center. At 6 a. m. the retiring search patrol commenced at 15 knots, the scouts reaching position *A2-D2* at 6 p. m. During the night the scouts retire at 10 knots, reaching at 6 a. m. the position *A3-D3*. Then the retiring search is taken up again, the scouts arriving in position *A4-D4* at 6 p. m. Therefore, after 36 hours of search at an average speed of 13.3 knots the required sector has not been covered.

If listening devices could be used to continue the search during the night, the scouts by running at an average speed of 15 knots with a speed of 20 knots while under way, could have reached the position *A5-D5* by 6 a. m., thus completing the search of the required sector. Therefore, it will be readily seen that the continuous search by the Retiring Search Patrol is far more efficient than the usual method in which searching is attempted only during daylight.

But it is not only in searching that listening devices will be of value. They can be used effectively in all night operations and during daylight when the visibility conditions are poor. When an enemy vessel is once heard during a night search a run of 30 minutes in its direction should bring it within the range of the listening tubes installed in the hull. Many of these devices can be used while the vessel is still under way and even if it is necessary to stop an accurate bearing can be taken in less than three minutes. When this close the class of the enemy vessel can be determined. If it is decided to attack, our vessel can be guided into position by means of the listening devices and the attack with guns or torpedoes can be made with the advantage of surprise on our side. If it is decided not to attack, then the enemy vessel can be easily avoided and its position can be reported so that, if considered desirable, superior forces can be concentrated upon it. In this way enemy forces can be reconnoitered during the night and their positions can be reported without ever getting within sighting distance. This will allow destroyers making a night torpedo attack to be guided to their targets and will facilitate the surprise of enemy surface craft by superior forces at daylight.

Listening devices will also be of great value in screening operations. At Key West a great number of practice attacks were made by submarines of the *K* class on surface craft escorted by submarine chasers; the chasers stopped to listen for three minutes in every twelve. In every case the position of the attacking submarine was accurately determined by listening bearings before it could reach a favorable firing position. In the same way surface craft escorted by vessels equipped with listening devices could be warned of approaching destroyers attacks in sufficient time to avoid them.

Listening devices will undoubtedly play an important part in naval warfare in the future. Therefore, every effort should be devoted to the development of new and improved devices and to the determination by actual practice of the ways in which they may be used to the greatest effect.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE CONSTRUCTION AND REPAIR DEPARTMENT AFLOAT, RECORDS OF WORK AND THE HULL BOOK

By Lieutenant R. R. Clarke (C. C.), U. S. Navy

The desirability of maintaining a record of the more important work undertaken by the mechanics of the deck force on one of the armored cruisers of the Pacific fleet led to experimental work along the lines described below during the years of 1916 and 1917. While the record has doubtless since been discontinued due to the inevitable changes in officer personnel and to the fact that regulations do not require keeping such records, the desirability of such a record aboard ship is so evident that the following description of the system is given as a means of directing attention to an important matter deserving of more consideration than it receives aboard the average naval vessel.

A record of work of this, or a similar nature, will obviously be of no practical value when carried over a period of several years, unless the information is carefully tabulated and filed so that data desired can be readily located with a minimum expenditure of time, and it well may be that the failure to keep such records heretofore is partly caused by a realization of the hopelessness of finding desired information in the usual form of record. Incidental to the record of work it is also desirable to systematize the work of the mechanics engaged, so that their time may be employed on productive work to the greatest possible extent, both through using the proper man on each job, and through having material available at the proper time. Such results can be more readily obtained when a considerable list of work is always available for allotment to the individual mechanics, paying due consideration to the varying degree of skill and the general dependability of each.

It is unnecessary and undesirable to record in a permanent file the majority of the work undertaken, since much of it has no particular interest or value after being completed. Some form of recording all current work is desirable, however, and the "Work

Books" used on many ships answer this purpose in an admirable manner. Loose individual job orders on a cruising vessel are open to many objections, not the least of which is the facility with which they may be mislaid or lost if sent to the shops. On the ship in question two work books were maintained, one for the carpenter's shop and one for the paint shop, in which all items of work were entered as their necessity became manifest. Items of work were entered in these books without particular reference to their urgency but with the date when entered preceding each item and a statement of the urgency of the item following, such as "urgent," "immediate," "when convenient," "prior to next coaling," etc. All items of work were entered on the left-hand pages of the open book leaving the right-hand pages blank for entries as to date of commencing work, date of completion, material used, and the name of the mechanic who performed the work. In general a list of material used was not required, but if a list was desired notation was made to this effect in entering the item of work. During working hours the books were in their respective shops but were returned to the chief carpenter's stateroom about 4.30 p. m. each day and were accompanied by any requests for material desired in connection with the work to be undertaken the following day. The work books remained in the chief carpenter's room overnight and went to the shops before working hours with any additional items of work entered and with signed chits for the material which had been requested. The items of work to be entered in the work books were derived from various sources, numerous items being received from the first lieutenant's office in the form of memo lists of items reported in the weekly hull inspections, items noted on special inspections, etc. Items of work involving the use of a considerable amount of material were covered by regular job orders on S. & A. Form No. 316 under Titles "D," "K," or "P" as appropriate, but such job orders when received were entered in the work books the same as other items and the job order retained by the chief carpenter until it could be reported completed. The majority of expenditures under these titles were made against regular standing job orders issued each quarter and each covering certain specific work, such as,

D-27. Charge to this number the cost of all material used in repairs to linoleum during the second quarter of 1916.

P-30. Charge to this number the cost of all material used in repairs to boats during the second quarter of 1916.

so that the only use made of the ordinary standing job order was in connection with the charging of material drawn out of store, to the appropriate job order number.

The chief carpenter's mate and the head painter were each responsible for distribution of work in their respective shops and for having the proper entries made on the right hand pages of the work books as jobs were undertaken and completed, however many of the entries were made by the men actually doing the work, after they became familiar with the requirements of the system. Especial effort was made to have these work books of interest and help to the mechanics by giving all possible information relative to special drills scheduled for the day, commending any work exceptionally well done, pasting in clippings or copying data relative to tap drill sizes, machine and wood screw sizes, pipe threads, etc., or any other items of interest that might facilitate their work. It was found to be very convenient to leave a number of pages blank in commencing a new book so that standing orders, special details, general instructions, etc., could be entered therein from time to time as occasion arose. Various sizes of work books were used, a book about 8″ x 10½″ with 150 to 200 pages is convenient, but in general too large a book is objectionable as it is subject to hard wear and should not fall apart before it has been filled.

The successful accomplishment of work requires co-operation between all concerned and an iron clad adherence to any system worthy of adoption is likely to meet with disaster unless discretion is used, especially is this true in any endeavor to establish definite times for the obtaining of material. The obtaining of material in advance is usually a matter of growth with even the best mechanics and is never fully acquired by some. It is of greatest importance therefore that chits for material should always be forthcoming at any time, encouraging the requesting of material at stated times but not insisting upon it. A mechanic should not be given the slightest excuse for feeling it might be better to loaf for an hour or two in order that an irregular request for material need not be made, as the officer who shows a disposition to hold his men to so-called "efficiency methods" for his own convenience is soon correctly tabulated by them and imitated in ways not calculated to increase efficiency. Likewise it is desirable that when occasions arise, as they frequently do aboard ship, which require

that certain work be undertaken at once instead of in the routine way, the inconvenience of making a special trip to the shop for the purpose of writing the necessary order in the work book is well worth while in the effect it has toward establishing system.

As the work books described above contain all items of work undertaken by the mechanics and painters of the Construction and Repair Department of the ship with the dates of commencing and completing each item, the selection of those items which are to be permanently recorded is a simple matter and the actual recording can be undertaken at intervals as may be found most convenient. The permanent record in the case under consideration was contained in a card file of standard 5" x 8" cards with the necessary guides to insure ready access to any compartment or other subdivision of the file. This size of card was adopted on account of its being a convenient size for use in a typewriter, the desirability of having the permanent record typewritten being self-evident. The guide cards used were ⅓ cut and some of the actual guide card headings are listed as follows to suggest the arrangement of the file:

"A" compartments, 1 to 99.
"A" compartments, 100 and up.
"B" compartments, 1 to 99.
"B" compartments, 100 and up.
"C" compartments, 1 to 99.
"C" compartments, 100 and up.
"D" compartments, 1 to 99.
"D" compartments, 100 and up.
Stateroom records.
Auxiliary C. & R. machinery.
Drain valve record.
Ventilation systems.
Watertight doors and hatches.
Plumbing.
Fire main.
Flushing main.
Air and gunports.
Gun deck.
Main deck.
Bridges.
Boats.
Data for requisitions.
Sketches.
Drydockings and draft records.
Ship's force job orders.
(Titles "D," "K," and "P.")
Navy yard repair memo.
Unfinished navy yard work.
Alterations by ship's force.
Repair division data.
Miscellaneous.

Although not strictly required as a part of the record, descriptive cards were prepared in conjunction with the various subdivisions of the record, one of these cards was prepared for each water-tight compartment similar to that illustrated for compartment A-3 by Card No. 1. These descriptive cards were standard weight cards 5" x 8" but the record cards were of lighter stock cut from heavy durable paper and used on account of the greater

facility with which they could be inserted in a typewriter. The data on the descriptive cards was compiled with a view to its probable utility, in the case of "Boats" it contained the type, length, date and condition when received, hull number, engine number, etc., in the case of staterooms a list of the furniture and other equipment was given for each, and under the other headings such data were given as experience indicated would be of frequent value.

A-3. DRY PROVISIONS DESCRIPTIVE CARD U. S. S.................

Hold compartment between frames 11-16 on the starboard side from outer plating to upper platform deck. Entrance is through a water-tight hatch in the upper platform deck at the bottom of A-23 (Access Trunk). Compartment A-4 corresponds on the port side of the ship.

Compartment is drained through the secondary drain. The valve is in the after inboard corner of the compartment, is a 3-inch stop, check, and can be operated on the berth deck between frames 15-16 on the starboard side near the centerline.

Sounding tube socket for the compartment is on the berth deck between frames 13-14 on the starboard side near the centerline.

It is ventilated from Supply Blower No. 3. in the C. P. O. quarters. An automatic ball float valve protects the outlet in A-3 and a butterfly valve at the upper platform deck can be operated from the bottom of A-23. An 8-inch butterfly valve just above the protective deck can be operated on the berth deck between frames 14-15 on the starboard side near the centerline, this valve also cuts off ventilation from A-22 just above A-3. The supply pipe for A-3 is 4½ inches in diameter where it enters the compartment.

Painted area in the bilge below the floor boards is about 400 square feet and is painted with red lead paint. Painted area above the floor boards is about 980 square feet and is painted with inside white paint over red lead.

CARD NO. 1. (Standard weight.)

Card No. 2 illustrates record data for compartment A-3 and in the actual file followed next after Card No. 1, being for the same compartment. After filling the first record card a new one with the same heading marked (continued) would be commenced for the same compartment, making a continuous record for that compartment, all filed together and readily accessible at any time without a necessity for extended search to locate information desired. It is of course important that only such data be recorded as might be expected to be of future interest, otherwise a bulky file results with attendant difficulty and loss of time in locating

data. Duplication should be avoided as far as practicable but is necessary to a certain extent, as for instance, in alterations which must necessarily be recorded in some cases briefly under the compartment record as well as under the heading "alterations." A chronological record of alterations is very desirable on board ship and probably no other part of the record is of more real utility or interest or should be more carefully maintained, it should cover both alterations made by the ship's force and by repair ships or shore establishments, in order that a complete list of all important alterations may be available, but alterations accomplished by different forces can be carried on separate cards if considered desirable.

A-3. DRY PROVISIONS RECORD CARD U. S. S....................

1/28/17. All stores broken out and entire compartment cleaned out and repainted. Work done by 1st Division—Completed 2/12/17.

7/19/17. Compartment was critically examined, ventilation pipes blank flanged, conduit junction boxes, etc., were overhauled and an air pressure was applied. Preliminary test indicated necessity of calking the hatch bounding angle. After calking, an air pressure of 5 pounds per square inch was applied. This pressure dropped to 3 pounds in 20 minutes after air was shut off. Compartment considered in satisfactory water-tight condition.

8/25/17. Captain of the hold allowed fresh water tanks in the compartment above to overflow. About 2000 gallons of this water was drained into the bilges of A-3 and pumped from there into reserve feed bottoms.

10/16/17. All stores were broken out, bilges cleaned, rust streaks scraped, and the paint work touched up. Work was done by the 1st Division—Completed 10/24/17.

CARD No. 2. (Light weight.)

Certain work aboard ship requires periodical repetition and work of this character can be typified by periodical overhauling of drain valves. It is desirable that each drain valve should be opened up for inspection twice a year but this schedule cannot be maintained with absolute regularity owing to the necessity of having stores or other gear broken out of some compartments in order that the valves may be accessible. The list of drain valves on the ship in question was not too lengthy to preclude its incorporation on two cards, one for the forward drain valves under cognizance of the first lieutenant and one for the after drain valves under his cognizance (all the midship valves being under the cognizance of the engineer officer). These two cards merely con-

tained a list of the valves in a column on the left side of the cards, the remainder of the space being used for pencil notation opposite each valve of the dates of overhaul, the purpose being to facilitate arranging schedules for drain valve overhauls. Card No. 3 illustrates the data relative to drain valve overhauls for compartment A-3 and in the actual file was placed in its proper numerical order after the guide headed "drain valve record" preceded by the drain valve cards for compartment A-1 and A-2 and followed by the cards for such "A" & "D" compartments as were provided with drainage arrangements. It will be noted that on this

DRAIN VALVE RECORD COMPARTMENT A-3 U. S. S.................

Valve is a 3-inch stop, check, on the secondary drain line. It is located in the after inboard corner of the compartment and can be operated on the berth deck between frames 15-16 on the starboard side near the centerline.

OVERHAUL RECORD

7/18/16. Overhauled by Bent, A. D. In bad condition, partly filled with trash, required grinding in and general cleaning and oiling.

12/14/16. Disassembled and examined by Godfrey, O. R., prior to refilling compartment with stores. In good condition, no work required except oiling.

8/26/17. Overhauled by Bent, A. D., after removal of fresh water from bilges of the compartment, valve was cleaned, dried, and oiled.

10/31/17. * * * Valve could not be operated on weekly test and it was found the wood casing for valve operating gear had been slightly broken while stowing compartment so that the bevel gears were jammed. Casing was repaired and valve then tested out O. K. Work done by Bent, A. D., and Smith, L. A.

CARD No. 3. (Light weight.)

card the descriptive data does not require all the space and that the record data is commenced on the same card to utilize space to the best advantage.

The brief description given of this file and the cards shown will suffice to give an idea of the practicability of the file but only actual experience in the keeping of data in such form can prove the usefulness of the system and the frequency with which information is derived from it after the commanding and other officers discover that accurate information is available on short notice. Some of the most useful sections of the file are those containing sketches of makeshift target rafts, splash targets, towing spars, special fittings frequently required on requisitions; data for requi-

sitions such as, sizes, type, length and quantities of machine screws for the various hatches or doors on the vessel, the quantity of paint required to paint the ship outboard, or lists of the sizes of gasket rubber required for all purposes on the vessel, since such information allows making prompt estimates of stock required for any extensive work. Few officers engaged in C. & R. work aboard ship care to spend the time necessary to inaugurate a satisfactory filing system covering their work because of the practical certainty that successors will scrap the system and start another one, or more likely fail to keep any at all. If however, a system were devised sufficiently flexible to suit the varying requirements of at least the more important ships and maintenance of the system made obligatory, its continued upkeep should be practicable and profitable both in connection with the maintenance of the vessel and as a means of education to the personnel concerned. Although in the case under consideration the file was not an adjunct of the first lieutenant's office, such a file if kept, should be in his office and could be largely maintained by his yeoman if all officers concerned were required to report in writing any data to be filed therein. Such data should of course be scrutinized by the first lieutenant before being typewritten on the cards, to make certain of its being in proper form and desirable for addition to the file.

An excellent system had been in operation on this vessel for a number of years in connection with maintenance of the hull book and, since this record is more or less allied with the record of C. & R. work, it will be briefly described. The book consisted of a binder for loose forms printed on cap size paper leaving wide margins at the tops, as they were secured in the binder by their tops. All reports were required to be in the first lieutenant's office by Monday morning of each week, they were inserted in the binder after the first lieutenant had looked them over and filled out his form emphasizing any items of special interest and adding any items of his own. The book was forwarded to the executive officer by Tuesday morning for his perusal and he forwarded the book to the commanding officer not later than Thursday morning. The commanding officer's inspection was regularly held on Friday afternoon of each week and the above schedule allowed the commanding officer to look through the hull book prior to making his inspection and thus have advance information rela-

tive to the work considered of prime importance by the heads of departments, division officers, etc., after completing his inspection he could again refer to the hull book and note if officers had overlooked reporting conditions which he had noted during his inspection. On Monday morning the hull book was returned to the first lieutenant's office to commence another round. The older reports were removed from the hull book from time to time to prevent the book from becoming inconveniently bulky but a number of the later reports were retained in the book at such times to allow of comparison with new reports, if desired.

The following named officers were required to submit reports in the hull book each week and each reporting officer had his own special form to fill out:

1st lieutenant.	Medical officer.	1st division officer.
Engineer officer.	Supply officer.	2d division officer.
Gunnery officer.	Chief carpenter.	3d division officer.
Navigator.	Chief electrician.	4th division officer.

Each form was printed on cap size paper and punched on the top end for insertion in the hull book. The forms differed slightly in wording but in general were much alike, the list of compartments in each case being arranged in tabular form down the left margin of the form leaving all the space to the right of the column for notes as to condition or items of work required. The form for the 1st division officer is illustrated in Fig. 1, but to save space only a few of the compartments numbers are entered.

U. S. S. .... 191-.

I have completed the weekly inspection of all compartments, watertight doors, and mechanical devices for the safety and management of this vessel which come under the cognizance of the 1st Division Officer and find the condition of same to be as follows:

A-1
A-2
A-21
Etc.

....
1st Division Officer.

FIG. 1.

The supply officer, being in charge of store rooms, issuing rooms, etc., reported on all such compartments as were under his cognizance; and the medical officer reported on compartments in

which medical stores were kept, the sick bay, operating room and kindred compartments, as well as on the sanitary condition of all living compartments, cold storage compartments, galleys, pantries, laundry, etc. The forms for the first lieutenant, chief electrician, and chief carpenter did not contain lists of compartments and the forms for these reports are illustrated by Fig. 2, 3, and 4, respectively. In the case of the chief carpenter a typical report is shown to show how items previously reported as requiring work were reported completed. Uncompleted items were reported on each successive report until they could be reported as completed and items of work beyond the capacity of the ship's force were followed by the statement that they were beyond the capacity of the ship's force, had been added to the list of work to be requested at the next visit to a navy yard, and would not be reported on subsequent hull reports.

U. S. S. .... 191-.

I have had the weekly inspection of all compartments, water-tight doors, hatches, air ports, and all mechanical devices for the safety and management of this ship under the cognizance of the first lieutenant made and defects are as reported by Division and other officers reports herewith.

....

First Lieutenant.

FIG. 2.

U. S. S. .... 191-.

I have completed the weekly inspection of all electric light systems, call bell systems, fire alarms, battery control systems, long arm system, and operation systems and find the condition of same to be as follows:

....

Chief Electrician.

FIG. 3.

There are a number of advantages in keeping a hull book by this system but perhaps two of the most important ones are that the reports are put to actual use in the ship's routine of work and inspections, which tends to promote making the reports more than a mere form to barely comply with the regulations, without the added incentive that the reports are scrutinized each week by three of the vessel's ranking officers; also that the reporting is systematically divided up between a number of officers each of whom is reporting on matters directly under his cognizance so that rela-

tively complete reports can be obtained without undue burden on a few officers. Too much emphasis cannot be laid on the desirability of having reports made aboard ship in a shipshape manner as a means of training of the personnel.

U. S. S. *Speed*, May 19, 1917.

I have completed the weekly inspection of all compartments, watertight doors, hatches, air ports, and mechanical devices for the safety and management of this ship coming under the cognizance of the chief carpenter and find the condition of same to be as follows:

All in apparent good condition except as noted below.

1. Operating gear for the armored hatch in the protective deck to A-23 has carried away and new shaft and pedestal casting are required. This item has been covered by a letter requesting new parts on our arrival at Balboa. Hatch is secured in open position, but can be closed, if necessary, by using chain falls.

2. Starboard whaleboat is leaky and requires recalking. This work is being deferred pending arrival in port to allow getting boat in a convenient location for the work.

3. After fresh water tanks require cleaning out and cement washing. This work has been completed in connection with all forward tanks.

4. Air ports in staterooms Nos. 17, 19, 20, and in isolation ward are leaking slightly. Gaskets will be renewed on arrival in port.

5. The 45-fathom shot of chain on port anchor is badly chafed and strained in connection with recent salvage operations and cannot be considered reliable. It should be shifted and replaced by the similar shot in the port sheet locker, for which no anchor is provided.

6. Compartment A-20 is continually wet through excessive sweating of the compartment. Sweating is due to fact that steam line to ice machine parallels closely the fire main. No remedy appears practicable at present time, but sweating is reduced somewhat if compartment is kept closed up.

7. An armor bolt in cofferdam A-100 allows slight leakage from outboard. A new grommet will be installed after arrival in port and this will probably stop the leakage.

8. Linoleum amidships on the gun deck is in poor condition and repairs are being made as rapidly as more urgent work permits.

9. Staterooms 23, 25, and 30 require repainting and furniture should be revarnished. Rooms are occupied at present and this work cannot be undertaken.

10. Fire hose for fire plugs Nos. 3, 34, 41, 42, and 47 is worn out and requires renewal. New hose is available at Balboa and necessary replacement will be accomplished prior to departure from that port.

All work necessary in connection with items Nos. 3, 4, 6, 8, and 10 in my report for the previous week has been completed.

H. R. SWIFT,
Chief Carpenter, U.S.N.

FIG. 4.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

PIPE SWEEPERS

By COMMANDER C. N. HINKAMP, U. S. Navy

Few people except those present when they sailed know much about the minesweepers that left these shores for the mine fields of France. Owing to the activities of the censor, no information was made public concerning the outfitting of the United States mine sweepers that operated off the French Coast during the war. How many ever heard of "Squadron Four, Patrol Force" which swept enemy mines off the French ports when the submarine menace was at its height? And how many know anything about the mine sweepers of the Allies before we entered the war? Few. Few outside of those who had to travel the channels and areas mined and then not until these areas had been swept or cleared of the danger. The knowledge of clear channels is a much needed one when troops are being transported, and were it not for skillful sweeping, many more soldiers and sailors would be among the missing. Hence the sweepers and this story.

Let us go back to August, 1917, four and a half months after the declaration of war with Germany. One by one the converted wooden fishing steamers commonly called "porgie boats," familiar to all coastwise sailormen, came into Boston from various navy yards along the coast, to get their orders and make final preparations for sea. "Where do we go from here?" was heard on all sides. The fishing steamers were about 160 feet in length, 25 feet beam, draft 14 to 15 feet, displacement about 400 tons, speed 9 knots, and capable of carrying close to one million fish with a full hold and decks piled high. The rebuilding consisted of enlarging the deck house to accommodate more men, moving the pilot house to the rear about ten feet to make room for a gun forward, fitting part of the fish hold as a magazine and store room, and mounting two guns, one forward and one aft. Additional coal was carried in the remaining space in the fish hold, and enough ballast was added to compensate for the high location of the guns. Ordinary life boats, life preservers and a life raft com-

pleted the conversion from a fish boat to a man-o-war. A complete radio outfit and a typewriter were added to increase efficiency, as well as a machine gun and a depth charge.

It was my luck to miss the rebuilding period these boats went through, the assembling of the crews and other drudgery in connection with the organization. My telegraphic orders brought me to the scene twenty hours before the time set to sail so I had little to do but say goodbye, coal ship, take on life rafts and water, inspect the ship, learn her needs of which there were many, get acquainted with the officers, investigate the grub situation, report to my senior in command of the squadron, inspect the guns, and get my orders. I might add that in this period I found leisure enough to unpack my bags, get my cabin in order, and make out endless reports which some one wanted before sailing. All red tape was not cut even during the war, but thank heaven we cut enough to get away on time. I hope there will be no reckoning for eighty years. We were informed that on the next day, Saturday the 25th of August, our entire convoy of ten sweepers, six submarine chasers, one collier and one yacht (the flagship) would rendezvous at Provincetown, Massachusetts, and sail from there some time Sunday, hour unknown, weather uncertain, destination a secret. By noon Sunday all but one sweeper of the convoy were there, and we were told to be ready at 4 p. m. We were a motley assortment of ships, camouflaged according to the wildest fancies of three schools, all the colors of the rainbow, all the effects which delirium tremens could envy but not duplicate. And on the docks watching this scene were the fisherfolk of Provincetown, a few of the wives of those about to sail, and the local patrol crews. Captain Y——— of the *Bessie Q.*, who had sailed on the fishing banks for many a season remarked that he'd never take a steam fish boat across the ocean, and that it was suicide to attempt it. This and others like it were the cheering sentences heard on all sides, and such were the delightful impressions left in the minds of those who had to remain behind.

It was a bright day, clear and reasonably warm, wind from the Northwest, barometer "high and rising" and good weather was predicted for several days. Promptly at four o'clock we heaved in our anchors, by hand and it was some job, housed them for a long trip, and headed out of the harbor for the open sea. The straggling sweeper joined us, so our convoy was complete, and in a short time we got into a semblance of the prescribed

formation, and by nightfall we had left the good old U. S. A. on the western side of the horizon. The collier, the *Bath* by name, formerly a German merchantman, and the *Wakiva*, the yacht led the parade, the sweepers formed in line of divisions, and the six sub-chasers filled in odd gaps in columns of three. It was a sight to strike terror to any submarine, one fisherman allowed it was not the submarines he feared, it was the sea, for had a submarine seen all of us an attack was unlikely, while if a real sea hit us we would have sunk without a trace. Later developments showed he was correct.

U. S. S. "MCNEAL" MINE SWEEPER.

Our departure from Provincetown, the landing place of the Pilgrims, was a success; that is, we got in and out and no one knew where we were going. About ten miles out we opened our orders and learned that Ponta del Gada in the Azores was to be our first stop, 2200 miles away, and no intermediate station to rest in. The submarine chasers had fuel to cruise about 700 miles only, so they had to be towed most of the way, six of the sweepers being detailed for this duty. This phase of the trip is a separate story in itself with the breakdowns of engines, parting of towlines, and other incidental mishaps. One evening at dusk, about 1500 miles out one of the chasers which had parted her towline came alongside and asked for a tow. We said "sure if you will go to the supply ship *Bath* and get us two hams and a bag of flour."

We never dreamed it would be done, but about three hours later in the inky darkness mister chaser came alongside, threw two hams and a bag of flour on board and at the same time heaved us his towline. He had earned his tow, so we took the line, made fast, and had a fine time towing this bird the rest of the way. This is but one of the many incidents of the voyage.

The weather was excellent, had it not been, another tale would be told, for the cruise was a long one and coal capacity limited. The sweepers had their share of troubles, hot bearings, salty boilers, lack of food, lack of proper cooking utensils, and other omissions due to a hasty getaway. The trip took eleven days, an excellent run and with but two days of bad rolling due to a severe swell and steaming in the trough of the sea. My bunk was an athwartship affair, and by bracing myself with many pillows at head and feet I was able to stay in one place in the bunk, but was either on my head or on my feet all the time until I decided that standing was the only real way to rest on that packet Upon leaving Boston fully loaded the average height of the deck above the water amidships was about 12 inches, not very much, and all day and all night, every day, the seas swept across the well deck. The swish swash of the water across the deck will always be a fond memory. In the morning of the tenth day we sighted Pico, a high mountain in the Azores, and on the eleventh day we steamed into Ponta del Gada, the submarine chasers gaily following under their own power. We had heard of the Azores, few of us had seen them, and rocky as it was, that land looked good to us, and glad we were to get in the harbor, all safe and without any major casualties to mar the voyage.

It is customary in most foreign ports to take a pilot on board to guide the ship safely to proper anchorage, but in the case of a squadron or fleet of men-o-war one pilot on the flagship is considered enough. The pilots association of the Azores must have a powerful organization politically, for no matter how much we refused to stop to take them on board, the more they persisted in getting aboard. We saw the flagship had taken a pilot, no more seemed necessary, but no, each vessel must have a pilot. The one that got aboard my ship finally got a good wetting which didn't improve his disposition. Pilots as a race are a jealous lot, but professionally able men. It was a comfort on mooring to see five coal burning destroyers and their repair ship already there. The *Panther* was a blessing, for with her aid we made all

the minor repairs necessary to continue the voyage. The harbor was full of all kinds of craft, and the inevitable bumboat with its load of fresh fruits and pastry. We ate the fresh fruits, the pastries were too heavy and unlike anything that mother used to make.

During our stay of six days we filled with coal and fresh water, took on food, made minor machinery repairs, and permitted the officers and men to go ashore for relaxation. They did. Several signs indicating the sale of local beverages had a delightful effect, immediately the world in general and the mountain scenery in particular took on a new aspect. One bright morning all the vessels were ordered out to hold target practice. We had held none before leaving the States and few of the men had ever heard a gun fired, much less seen one fired, or fired one. On the way to Azores we had exercised twice daily at subcaliber practice, shooting at blackfish with machine guns, and held the other usual drills at sea. We were anxious to try out our magnificent battery of two 3-inch guns. It was a funny practice as we look back upon it, but it was serious business to us then, for we knew not when a submarine would appear and we must needs be prepared. Each vessel fired at a home made target towed by another vessel. The shooting was creditable. The officers at the guns tried hard, so did the men. All hands learned a lot. While we were out shooting the flagship called all vessels within hail, delivered each a set of orders, and without a chance to say goodbye to the Azores, we left their refuge for France.

Our destination was Brest, the knowledge of which settled many an argument for we had visions of Gibraltar, Marsailles, Bordeaux, and even Queenstown. This leg of the trip was about 1200 miles, it took seven days, we met stormy weather for two days cutting our speed materially, and also making several sea sick, even those who were generally immune. In a fog all ships got separated more or less and we missed the *Bath* and one sweeper. The sweeper appeared in a haze the morning we arrived off Brest, but the *Bath* did not show up until much later. For a wandering child she took the prize, running alone in a dangerous area, over mine fields and near rocks, and finally was escorted in by a patrol vessel sent specially to look for her. The crews of the chasers being French felt that they were arriving home and believe me they cruised around joyously, maneuvering all over the place, showing off and getting in the way. You

have all read about Brest, wet, damp, and generally rotten weather. Whatever bad is said about Brest weather comes nearly being true, for it rains about 330 days of the year, it has plenty of fog, and the streets are always muddy. Well, here we were after 3400 miles of cruising, the U. S. Naval Headquarters in France, with plenty to do and all ready to begin. The admiral decided to give us a brief rest for a few days which we appreciated.

Mining activities by the Germans at this time, September, 1917, had subsided to a routine planting in regular channels, and the French found it no trick to get all that they had planted. So it was decided to place sweepers on escort duty with the yachts and other small vessels based on Brest. Escort duty consisted in accompanying merchant convoys on their trips down and up the coast, keeping them in safe waters and protecting them against possible submarine attack. The route of the convoys was particularly subject to submarine attack, and many a good ship found the bottom near the French Coast in spite of the care and protection of the escort, but many more ships would have been sunk were it not for them. The sweepers took to this duty with enthusiasm, but it was short lived, the first schedule was attempted and almost accomplished when the news of the sinking of the *Rehoboth,* one of the sweepers, put a crimp in the idea that these boats were seagoing. There was a good blow on, and these blows being of frequent occurrence in these waters at this time of the year it was decided to take the sweepers off this duty and install the French mine sweeping gear. In November the mine-laying activities of the enemy were revived, and work on the sweepers was rushed. During the progress of this work several officers and men were detailed to go out with the French sweepers to learn their methods in handling the system of sweep or drag. By December some of the vessels were ready, we left Brest and established our base at Lorient from which we carried on all operations. By January all the sweepers were finished and joining the forces at Lorient. The French method of sweeping possessed features of great advantage over any other system for these waters. The sweep or drag was called the "single ship" drag; that is, there was but one ship on each drag and each vessel could act independently. In other forms of sweeping there was generally two vessels acting together in pairs. By an ingenious arrangement of kites, similar to paravanes used by larger ships, a large "V" or wedge of wire cable was dragged through the water

at any predetermined depth. On the arms of this wedge were placed several explosive knives which, when the mine cable was engaged, exploded, cutting the mine anchor cable, whereupon the mine floated to the surface of the water. It could then be fired upon, blowing it up, or sinking it. Each sweeper could drag a path 200 yards wide, so that five ships could clean a channel ½ mile wide with ease. With an arrangement of floats and pendants to the kites the depth at which the dragging was done could be regulated to a nicety. In any given area the soundings would govern the depth of sweeping. In order to conserve the ships engaged in the operations, and to take advantage of all factors of safety (of which there were few) most of the sweeping was done on the high tide. The tides on the coast of France cover a wide range, in some parts being as much as 33 feet. Where we swept, between Penmarc'h Point and St. Nazaire, they had a range of about 14 feet. The draft of our vessels having been reduced to 12½ feet by the removal of much gear and a gun, allowed a range of about 6 feet during which sweeping could be carried on with a reasonable assurance of not hitting an anchored mine, as they were set to remain about three feet below the surface at low water. This meant that sweeping could be carried on during about five hours a day, during daylight. In the summer months when the sun rises early, and never seems to set, we could sweep on the morning and evening tides, but this was seldom done, and only when a troop convoy was expected. Our principal work was the exploration sweeping along the coastal convoy routes. In this sweeping no regard was paid to the state of the tides, as the convoys traveled at all hours of the day or night, and the channels had to be cleared for them. These routes were explored every other day, and the troops convoy routes to St. Nazaire were swept just before the arrival of the transports.

The ten sweepers that went over in August, 1917, were *McNeal, Cahill, Anderton, Hinton, Rehoboth, Lewis, Bauman, Courtney, Douglas, James*. Two others were supposed to join the party, the *Edwards* and the *Hubbard*. The *Hubbard* finally got over later on in the year, but the *Edwards* had to return after making a start, as she almost foundered in a storm off Halifax. Of the eleven sweepers that got over there are six left and they are still in France, unable to get home. The first one to be lost was the *Rehoboth,* in a blow off Ushant while on escort duty. The next one was the *Bauman*. She hit a rock near the Glenans outside of

Concarneau, stove a hole in her bottom, and before she could be towed to safety took a plunge to Davy Jones' locker. No lives were lost on either sinking. During the sweeping operations covering almost a year there was not a single casualty to a ship from a mine, although mines had been exploded in the sweep on more than one occasion. After the armistice, and after the sweepers had completed all the post-war dragging to insure no remaining mines, they were ordered to Brest to fit out for the trip back to the States. They started out for home, nine of them, all gaily decorated for the westward voyage, but before twelve hours had elapsed the Bay of Biscay had swallowed up three of the sweepers, the *James, Courtney,* and *Douglas,* and one of the large tugs that had come to assist them, the *Gypsum Queen.* The six sweepers that remained afloat got back to Brest, they had a battle royal to do it, and the fight against an almost forlorn hope is a bright spot in perpetuating the traditions of the service. All thought of trying to bring these six boats home is now gone, they are worn out, their machinery needs repair, and they are to be sold for what they can bring. This is the sad fate of Squadron Four the only U. S. mine sweepers that operated during hostilities off the coast of France where the enemy mining was a menace to the transportation of troops.

There was never an idle nor a dull moment for the sweepers. They were handy for all sorts of duty. We answered nearby calls for help, patrolled suspected areas, listened in frequently at night for the submarines, assisted in the salvage of several wrecks, rescued a few aircraft, did odd towing jobs, assisted in organizing outgoing convoys from Quiberon Bay, and all in all filled in every odd gap in the work of the district. These operations fitted in with our program of sweeping, there was never a call that we did not answer, and as you sit reading this effort, close your eyes and picture a convoy of transports arriving off the coast of France, to make the last dash for port before any submarine could get them, to have but one more menace to overcome, that of the mine fields, and to feel and know that the squadron of sweepers barely visible on the horizon have made that last part of the trip safe, and after sweeping the channels, were there to pilot the transports in to a safe anchorage, or lead them down swept channels to their final moorings in the port of debarkation.

DISCUSSION

Director Fire a Century Ago

(SEE PAGE 1097, WHOLE NO. 209)

REAR ADMIRAL BRADLEY A. FISKE, U. S. Navy.—The writer of "Director Fire a Century Ago," published in the July PROCEEDINGS, shows a surprising misconception of the essential feature of director firing, which I, as its inventor, beg leave to point out to your readers.

I made application for the patent in the United States on May 15, 1890, and in other countries shortly afterward. Naturally, I knew of the methods of concentrating the guns to hit a certain target, which the writer of the article describes, because I had made recitations on them frequently at the Naval Academy. I knew, however, that those methods were used simply to secure lateral concentration, and were effective because the distance to the target was small, as compared to the distance between the guns. I also knew that they had naturally gotten into disuse as the ranges had gradually increased.

In 1890, the main difficulty in hitting the target was in noting when the gun was at the correct angle above the horizontal, and arose from the difficulty of keeping the pupil of the eye exactly on the line joining the front and rear sights of the gun; and the difficulty increased—(and increased greatly) with any increase in the rolling of the ship. To overcome this difficulty, I invented and patented "A Method of Pointing Guns at Sea" which is now called the "Gun Director System."

The Patent Office brought forward in opposition to the claims I made a number of "references" to past and present methods and apparatus of many kinds; but finally on Sept. 9, 1890, it granted me the following claim:

"The method of pointing a gun located on a rolling, heeling or vibrating platform, which consists in adjusting a telescope, also located on said platform, and movable on a transverse axis, approximately parallel to that of the gun, at an angle to the bore of the gun equal to a certain predetermined angle *of elevation* necessary to cause the projectile fired from the gun to travel to a given target, and second noting the moment when the line of sight of said adjusted telescope is caused *by the movement of said supporting platform* to intersect said target."

Inasmuch as the Director System of to-day is exactly described by the phrases of the above claim, except that certain *additions* have been made to the original apparatus; inasmuch as it is a matter of common knowledge that the Director System is most effective (as compared with others) where the rolling is the worst; inasmuch as the writer of "Director Fire a Century Ago" states flatly "In case of heavy rolling the (marine) theodolite was *not* used to show the instant of firing, because of the

ballistic action of its pendulum, ***but was employed only for conning the helm";*** inasmuch as the scheme described in his article was therefore wholly different in principle from that of the Director System; and inasmuch as the history of my invention has often been described (notably in this magazine), the appearance of this article is most disconcerting.

U. S. NAVAL INSTITUTE

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Illustrations Authors of articles submitted are urged to furnish with their manuscript any illustrations they may have in their possession for such articles. The Institute will gladly co-operate in obtaining such illustrations as may be suggested by authors.

Original photographs of objects and events which may be of interest to our readers are also desired, and members who have opportunities to obtain such photographs are requested to secure them for the Institute.

Annual Election Proxies for the annual election have recently been mailed to the membership. It is requested that all members fill these out and return to the Institute as soon as possible.

Notice Whole Nos. 6, 7, 10, 13, 14, 15, 17, 144, 145, 146, 147, 149, 155, 167, 173 and 179 of the PROCEEDINGS are exhausted; there are so many calls for single copies of these numbers that the Institute offers to pay for copies thereof returned in good condition at the rate of 75 cents per copy.

ANNAPOLIS, MD., August 15, 1920.

INFORMATION INDEX

PROFESSIONAL NOTES

PREPARED BY

LIEUT. COMMANDER H. W. UNDERWOOD, U. S. Navy

GENERAL ARRANGEMENT

FRANCE

FRANCE'S NAVAL POSSIBILITIES.—The 1920 Marine Budget, amounting to nearly £40,000,000, has just been voted by the Paris Chamber after an interesting discussion, in the course of which were raised many points of international importance. The Breton Député de Kerguézec, who acted as Rapporteur du Budget, and is well known as the protagonist of a vigorous naval expansion on jeune école lines, bitterly criticized the Admiralty management, and especially the reduction of 28 per cent that has been made in the original estimates (whereas the Army Budget was only reduced by 4 per cent), and patriotically warned his countrymen against the deadly sin of indifference towards the navy. In truth, his sarcasm and reproaches were somewhat undeserved, the attitude of Messieurs les Députés showing their consciousness of the vital value of sea power to France, and their willingness to consent to all the sacrifices that may be deemed necessary in the near future. In this respect a great difference exists compared with the previous Chamber, no dissenting voice this time being heard to mar the concert of enthusiastic praise that was made of Mathurin's past and future services. Cardinal Richelieu's time-honored saying that "without maritime strength France could neither profit by peace nor successfully wage war" was solemnly recalled and unanimously applauded. Ex-Minister Thomson deplored the relative decline of the "marine républicaine," gloomily hinted at the use America and Japan might be tempted to make of their rapidly-growing supremacy, and urged "la nécessité d'un effort résolu."

From the subsequent declarations by Deputés Lecour-Grandmaison (an ex-naval officer), de Kerguézec, Boussenot, and Minister Landry, it is obvious France realizes the deep change the war has brought in the balance of sea power and the new requirements that confront her. The contest for the mastery of the ocean is virtually between the world island and semi-island powers, viz., Great Britain, the United States, and Japan. For the present America retains the supremacy on paper, but the superior

human and strategic assets of Britain were acknowledged, and de Kerguézec expressed the hope that "l'Angleterre ne se laissera pas ravir le sceptre de Neptune," and has, for the time being at least, the means of leaping promptly to her traditional place whenever she chooses, although the future might belong to the New World. Constructor Laubeuf has long since foreseen the present situation, when the mastery of the high sea would be a matter solely for island powers. Moreover, the size and cost of battleships are increasing at such a rate that only those nations can afford to build them who have practically unlimited financial resources, and are relieved by their geographical situation from the obligation of keeping a large and expensive permanent army.

France, despite her natural wealth and wonderful recuperative power, that is already asserting itself, cannot forget that the Versailles Treaty has been framed in such a way as to tie her to the guard on the Rhine, and so as to oblige her to keep a huge standing army (now over 700,000 men) in readiness to repel the aggression of a Bocheland numerically superior (over 60,000,000 people against under 40,000,00), and rendered all the more formidable by the disruption of Russia and suppression of her fleet that enables her to concentrate her efforts on the preparation of land and aerial attacks. Marshal Foch's authorized voice has just called public attention to the permanence on our Eastern frontier of a vital danger which the war has augmented rather than diminished. No wonder France should claim to have the most fought and suffered and the least gained by the war, when all points are considered. Generations will come and pass before the last traces of Boche devastation and ruin can be wiped out; and "economic reconstruction" are the words heading the programs of all our statesmen.

At the same time France means to be safe, and in waiting for the battle-cruiser program advocated by several leading admirals she intends to keep "une flotte vivante quoique réduite, et une défense des côtes parant à toute alerte possible" (Député Lecour-Grandmaison), which is the very program Minister Landry has at heart to realize. Député de Kerguézec, whose views as a future Minister of Marine deserve some attention, was even more explicit: "Pour le moment, nous n'avons pas les moyens de créer la grande armada dont le pays est digne, mais nous pouvons au moins avoir une flotte qui nous permette de rester libres de nos destinées et de choisir nos allies" ("For the present, France cannot afford to build the great armada that would be worthy of her, but she can at least be strong enough on the water to remain independent and at liberty to choose her allies"). This recalls the plea recently formulated by a well-known vice-admiral in favour of a squadron of six super-battle-cruisers, supported by aerial and submarine auxiliaries, that could be placed at the disposal of France's Allies whenever comes the great contest for the command of the Atlantic.

Whilst ex-Premier Briand stated that France and England "ont un égal besoin l'une de l'autre," stand equally in need of each other, and all orators expressed Anglophile sentiments, it cannot be denied that some misgivings and mistrust exist on the French side as to the ulterior motives of some English politicians. Deputé Boussenot, for instance, asked if, in the light of the Scapa Flow affair and of the interdictions concerning the surrendered Boche submarines, it did not look as if "notre alliée Anglaise voulait nous empècher de reconstituer notre marine." At the same time, both leading deputés and journalists expressed their confidence in British fairness and loyalty. Ex-Minister Chaumet advocates a frank understanding with England, who, in the actual state of the world, has less interest than ever in discouraging a tried and faithful ally such as France has been. "L'Angleterre n'est plus défendue par son insularité, n'est plus une île avec les progrès de l'artillerie et de l'aviation. Nos voisins et amis doivent se rendre compte de cette situation nouvelle."

Député de Kerguézec derided the Landry program (six large scouts, 12 2000-ton destroyers, twelve 2000-ton submersibles of 28 knots, and numerous bombing seaplanes) as being inadequate, and declared he could not be satisfied with less than 94 offensive submarines, whilst Minister Landry depicted an efficient coast defence as the solid foundation of French sea power and security, and no wonder. Coast defence, that would be a negative asset in the case of Germany, means much more than the word implies for the mistress of Dunkirk, Cherbourg, Bizerta, Diégo-Suarez, and Dakar. Super-cannon, submarine and aerial flotillas could easily transform these now poorly-equipped points d'appui into formidable bases of offence, with extensive radius of action. At the same time coast defence is no longer susceptible of being efficiently organized on cheap lines. The Cuxhaven, Ostend, and Durazzo affairs point to increased possibilities on the part of coastal attack, whilst the advent of aerial and long-range bombardment requires something like a remaking of French maritime bases.—*The Naval & Military Record,* July 7, 1920.

FRENCH NAVY NOTES.—There is, among well-informed naval men here, substantial agreement on two capital points of the cruiser policy, viz., France, being financially unable to compete in numbers, possesses at least, in the tried inventive genius of her constructors and acknowledged lead of her artillerists, the means of excelling in the matter of quality, as expressed by real speed under service conditions and gun and torpedo range; secondly, the projected 5000-ton (30 knots, eight 5.5) scouts of the 1914 program, though remarkably designed, could but represent a poor investment at this stage, as the larger British, American, and Japanese cruisers, already afloat or in hand, could catch and sink them with the greatest ease just as if they were mere gun boats instead of respectable croiseurs légers. Therefore, the 1920 scouts are to be enlarged beyond 7000 tons, and, despite the claims of the new 5.5-inch that exceed 20,000 yards in range, they are to mount axially-disposed 7.6-inch weapons of new design.

Constructor Laubeuf, it is interesting to note, is in favor of limiting the rôle of the submarine, and condemns without reserve the piratical practice inaugurated by the Boche, although he considers guerre de course as quite legitimate so long as the rights of humanity can be respected—so long as the submarine is in a position to save the crews and passengers of the vessels that have been sunk. He further states that to abandon in fragile boats, in the mid-ocean, the human cargo of a sunken liner is contrary to international law, and declares it a great pity, for the sake of humanity and justice, that those who torpedoed the *Lusitania* and so many hospital ships have not been hanged as they deserve. On the other hand, he will have none of the proposed suppression of the submersible, which he derides as being both absurd and immoral, since "le sousmarin permet à une nation faible de se défendre contre une nation beaucoup plus forte en navires cuirassés." Especially, he sees in the submarine a necessity in these times of 43,000-ton battleships, which France could not build except at tremendous cost, and which Italy cannot think of constructing, as it is an antidote against bombardments and relegates battleship activitiy to the high sea.

For the next ten years, he urges, France must be content with a purely defensive policy, and make submarines the very foundation of her sea power, as submarines, single-handed, can command those seas in which the Republic has her vital interests, viz., the North Sea, the Channel, and the "whole" of the Mediterranean. Therefore, no need of huge underwater displacements. "Le grand sousmarin est inutile, même nuisible" for the twofold reason that a large submersible cruiser would cost some 35,000,000 francs (!)—thus the price of two 900-ton or of three 500-ton boats—and that in number resides mostly the efficiency of submarine warfare. What France requires to be safe and to effectively control

European waters is a very large number of submersibles of three distinct types, namely, boats of 900 tons to be improved copies of the Lagrange and of the British *L* class, and improved *Bellones* and *Armides* of 550 tons, together with minelayers of 450-500 tons, similar to the German *U C-46* type.

The contentions of the eminent originator of the submersible type, who has specialized in submarine construction, and has supplied designs to all leading navies, deserves, of course, every attention. At the same time, many of those naval men who have to handle submarines, differ from him on the questions of submarine displacements and of the actual possibilities of submarine warfare. Lieut. Jeannin, who has just summed up in an interesting volume the result of his war experience and reflections, writes on this subject: "Le sousmarin ne peut aspirer à la suprématie des océans entrevue un instant en 1917. Since the progress of detection devices and appliances has deprived it of its chief advantage, his invisibility, and made it highly vulnerable to surface ships." No doubt, numbers may minimize the danger of this growing vulnerability of the submarine, but there is much to be said for large armored submarines carrying battle calibres. The British *M* class have many admirers on this side, and the question has been considered in high quarters of building larger copies with better stability, armored decks, and adequate ammunition supplies, the plea being that vessels so equipped would enjoy a larger radius of action, as well as a much more extensive scope of usefulness than sousmarins proprement dits of the *Laubeuf* design, only carrying torpedo tubes, and consequently, limited as to their means of offence and opportunities for action. Great inventors are notoriously partial to their own creations, and Monsieur Laubeuf does not want "son submersible" to be spoiled by the adjunction of guns and armor that savor of old-time warfare.

In the matter of administration and of the utilization of the Marine Budget, the French Navy labors under difficulties that are unknown to the British naval service. Whereas the English maritime authorities, supported by the business-like instinct of the British public, have only the superior interests of the country to consider as to the way the naval expenditure is to be distributed among the various ports and branches of the service, the good-intentioned politicians who every few months keep replacing one another at the head of the naval affairs of the Republic are never completely freed from electoral pressure. Toulon publicans held indignant meetings when Admirals Germinet and de Lapeyrère took out the 30,000 odd crews of the armé navale to sea for occasional maneuvers, and now an uproar and tearful protests are raised in the Chamber when vital reasons are set forth for the suppression of the inefficient and strategically useless ports militaires of Lorient and Rochefort and of the costly state armor factory at Guérigny that was to show the way to economic and speedy production and proved a failure. State industry in any branch means inefficiency and waste, and the French Navy has had much too much of it; an attempt so far back as 1887 to do away with such a cause of weakness, by the clear-sighted Admiral Aube, brought about a Parliamentary storm and a Ministerial crisis. To-day, however, the need for strict economy, and the contempt all experts entertain for the 35,000 anarchistic parasites of the State arsenals are supporting Minister Landry in his patriotic resolve to obtain a full return for every naval penny expended. The 1920 Marine Budget, just voted, is a monument of waste and inefficiency, as demonstrated by Deputés de Kerguézec and Brousse. It was contended by Déouté Balanant (an ex-arsenal hand) that the prolétaires des arsenaux are in reality "braves gen" and efficient workmen. Unfortunately, facts speak clearly enough on that score. In contrast with British naval workers, who understand that their welfare is dependent on the welfare of the British Navy at large, French "ouvriers des arsenaux" go counter to the interests of the service that feeds them by sending anti-patriotic representatives to Parliament and by indulging in occasional

sabotage, without mentioning their well-established reputation for laziness and total absence of zeal, though it appears things are not quite so bad as they were and a higher rate of production is being obtained since industrial methods were introduced by Minister Leygues in the Brittany arsenals. Ex-Minister Nail wondered why ports militaires, with their superior plant, could not excel private dockyards, and the Bolshevist député Goude claimed the Brest arsenal was the best equipped in the world; all remarks that go to show that no efficiency can be looked for where there is lacking healthy emulation and respect for authority, where there are lacking also business qualifications on the part of those entrusted with the management. As was remarked by Chief Constructor Maurice, our "ingénieurs de la Marine" would easily be the first constructors in the world if their unexcelled scientific training could be completed by the practical and nautical formation that is the strong point of their British and American colleagues. The attention of the Marine Minister is just now being directed towards that capital point, as it is obvious programs of maritime renovation can be little more than make-believe without the faculty of constructing quickly and economically, and an effort is to be made to enforce stability and responsibility in the management of dockyards, together with more practical competence. On the return from America of the mission of ingénieurs d'artillerie under Gen. Charbonnier a mission of French constructors is to carry out fruitful work of investigation and comparison in Allied shipbuilding centers. Thus a further sign of the thoroughness with which France is tackling the problem of her future maritime expansion.

The 850-ton aviso *Amiens* has had the most satisfactory trials of her class, having approached 21 knots, which is creditable enough considering the faulty lines of the hull and the difficulties in obtaining good-class building materials.

Whilst no illusion is entertained concerning the fighting value of these canonnières that would fall a prey to the smallest bona-fide scout, they will, on the other hand, prove useful to show the flag and for training purposes, besides preserving some worth for submarine purposes. Their relatively large number will permit of vastly increasing the list of young officers having on their shoulders the responsibility of independent command; and independent command is par excellence the school of initiative. As has been judiciously observed here, the remarkable spirit of enterprise British destroyer and submarine commanders displayed in the course of the conflict was a reward for the freedom of action which broad-minded British admirals allowed to youthful unit commanders, whereas in the Gallic Fleet that was practically concentrated in one armée navale; every move was subordinated to the bon plaisir of the admiralissimo, whose mind was filled with the image of bataille d'escadre on conventional lines. The recent Parliamentary debate happily showed that the enhanced value of initiative under the changed conditions of warfare is being fully realized in high quarters.—*The Naval & Military Record,* July 21, 1920.

FRANCE'S MERCHANT MARINE.—During the course of the debate on the French budget last month, a lengthy discussion took place in the Chamber of Deputies on the outlook for the French merchant marine. According to the official figures submitted, the French mercantile fleet at the outbreak of hostilities aggregated approximately 2,550,000 gross tons. Of this total, 1,100,000 tons were destroyed during the course of the war. All but 120,000 tons of this lost tonnage has already been replaced. Furthermore, the French authorities count upon receiving 450,000 tons of enemy shipping, and 160,000 tons of German boats acquired by Brazil. To this should be added 330,000 tons of new British vessels to be delivered in accordance with an arrangement made during the war and 1,089,824 gross tons of shipping building for French interests at home and abroad. When all these prospective units have been delivered, France will possess a merchant marine not far from five million tons.

It should be borne in mind however, that much of the tonnage just enumerated consists of old vessels, which have seen much hard service and are sadly in need of repairs. Unless thoroughly reconditioned at a very considerable outlay, these antiquated crafts cannot be profitably operated in competition with the enormous number of new cargo-carriers turned out in American and other yards during the last few years. Where the French with their depleted man power are going to find sailors to operate a merchant fleet twice the size of the one they had in commission before the war is a yet unsolved problem. That such seamen as are available are not especially amenable to discipline is evidenced by the fact that no less than thirty-three strikes occurred among them between January 19 and June 11 last.

While France in a short time will have developed her merchant marine on a scale undreamt of six years ago, a plan for the efficient use of this greatly enhanced merchant fleet has yet to be worked out. Nearly two-fifths of the tonnage under the tri-color is being operated by the government and the owners of these requisitioned vessels are not hankering after their speedy return as the onus of finding employment for these craft would then fall on them. One factor operating at the moment against the employment of much shipping in the coastwise trade is the neglected condition of the French secondary ports. For the last five years their upkeep has been entirely neglected with the result that they have become more or less silted and their quays have in many instances fallen in. So although the outlook for the French merchant marine appears roseate on paper, much remains to be done before this alluring vision of a great and prosperous fleet of ocean carriers under the French flag can become a reality.—*The Nautical Gazette,* July 24, 1920.

GERMANY

GERMAN SUBMARINE ENGINES.—This is the first instalment of a long article by a well-known German marine engineer.

"After a few words on general matters, the author states that the original German machines ran at 450 r. p. m., compared with 330 and 300 r. p. m. of two well-known makes of English machines; however, this speed of 450 r. p. m. was eventually reduced to 350. Materials presented some difficulty at one time, but eventually this was overcome by the improvement in steel foundry work. Steel and iron were used for all the large castings, which in the ordinary way would have been made of bronze. The cylinder covers, the valve chambers, and pistons were all made of cast-iron, the parts being specially prepared and cleaned up by sand blasting. The crank-shaft and driving shafts were of special steel, with a strength of 55 kg./sq. mm., all shafts being hollow. The crankshaft and other large bearings were of steel, with white-metal lining. The usual copper pipes for water connections were also of iron, leaded in the inside. The tests to which the engines were put were very thorough, consisting of seven days' continuous runinng, and 142 hours under full load. After these tests, the machine was completely dismantled for a thorough inspection. The principal tests were made when the engines were already in the ship, during which all conditions as regards weather, etc., were experienced. The author then proceeds to describe a 1,150 h. p. engine manufactured by Krupp and Co. This is the type of machine fitted to the *Deutschland* and *Bremen,* and also to the German-American Petroleum Co.'s tank ships, only in the latter case the engines are 4-cycle. Sectional drawings are reproduced of the engine at various points showing the working cylinder, lubricating pump, and fuel pump. Also indicator diagrams are shown, taken from this engine. The author describes a Diesel engine manufactured by the German Daimler Co., of 530 h. p., which is also illustrated by drawings. These machines have been gradually developed from the smaller type, 60 h. p., made in 1908." (M. W. Gerhards, *Der Motorwagen,* May 20, 1920.)—*The Technical Review,* July 6, 1920.

GERMAN NAVAL CONSTRUCTION, 1914-1918. *No. I.*—Information lately to hand from Germany supplements our previous knowledge of the naval shipbuilding programmes framed in that country during the war period, and throws a new light on the ambitious schemes that were entertained by the German naval authorities. It reveals no less clearly the indecisive and constantly changing views of the German Naval Staff with regard to the most promising methods of conducting the war at sea. For the first two or three months of the conflict they appear to have put implicit faith in the conventional weapons of naval combat—capital ships, cruisers, surface torpedo craft, and so on—to the virtual exclusion of the submarine. Not until the specular success of Lieut. Commander Otto Weddigen in sinking the three *Cressys* was anything done to enlarge the prewar programme of submarine construction. From October, 1914, confidence in the supposed unique powers of underwater craft dominated shipbuilding policy for a time, but by the summer of 1915 the palpable failure of the first submarine offensive against merchant shipping had caused the pendulum to swing back again, bringing the capital ship into favor once more. In fairness to Grand-Admiral von Tirpitz, it should be recorded that as long as he remained Secretary of the Navy a certain equilibrium was maintained in respect of naval construction. His purpose was to build the largest possible number of capital ships, cruisers and destroyers, in addition to submarines, believing, as he then did, that the war would end without a positive decision as between Germany and Great Britain, and that Germany's prospects thereafter would depend on the strength of her fleet. Moreover, he shared the common German view that the war would be of brief duration, and for that reason he did not consider it necessary to expedite the completion of the larger types of warships. Work on the battleships and battle-cruisers proceeded, therefore, at a leisurely pace, and was finally brought to a standstill through lack of materials and the preemption of labor for executing the huge submarine programmes introduced at a later date.

After von Tirpitz had been dismissed in March, 1916, something like confusion seems to have prevailed in German naval circles on the subject of shipbuilding policy, and various projects were adopted and cancelled with bewildering rapidity. To illustrate this confusion of ideas, it may be mentioned that immediately after the Battle of Jutland a decision was reached to lay down several capital ships of unprecedented size and power. Their dimensions can only be conjectured, but some notion of them is conveyed by the fact that the machinery for the battleships was to develop 160,000-shaft horsepower and that for the battle-cruiser 300,000-shaft horsepower—as compared with the 75,000-shaft horsepower of *Queen Elizabeth,* our fastest battleship, and the 144,000-shaft horsepower of the *Hood,* the largest battle-cruiser in the world. It does not appear that any of the projected German leviathans got beyond the designing stage, but the very circumstance that capital ships of this phenomenal size were seriously contemplated towards the third year of the war proves that the submarine did not by any means monopolise German interest. Eventually, a modified type of battle-cruiser, inspired by the British *Renown* class, was decided upon, and three vessels of this type were ordered in 1916. They are generally referred to in foreign naval text-books as the *Graf Spee, Prinz Eitel Friedrich* and *Ersatz Hansa,* but in Germany were officially designated *Ersatz Yorck, Ersatz Gneisenau* and *Ersatz* "A."

Although, as we have said, the design was inspired by our *Renown* class, the three German ships were considerably larger and had better protection. Their displacement at normal load was 33,500 tons, and their machinery—turbines, with Föttinger transformers—was to develop 110,000 shaft horsepower, the speed being estimated at a fraction above 30 knots. Revolutions per minute—turbines 1360, propellers 315. The system of protection was practically identical with that of the *Derfflinger,* viz., a 12-inch waterline

belt, 10½-inch barbettes and a 7-inch plating on the sides above the main belt, including the secondary battery. The main armament was to have consisted of six 15-inch 45-calibre guns, in three turrets, one placed on the forecastle and two on the afterdeck, No. 2 turret superfiring over No. 3. This was a reversal of the turret disposition in H. M. S. *Renown*, but was in harmony with the German principle of concentrating the heaviest possible fire astern. The 15-inch guns were given an angle of elevation up to 35 degrees. Sixteen 5.9-inch quick-firers were to form the secondary armament, and there were six tubes of the new 23.6-inch pattern. None of the trio was ever completed. The *Graf Spee* (*Ersatz Yorck*) was launched in September, 1917, after which very little work was done to her, and at the date of the Armistice the other two vessels were lying neglected on the stocks at Wilhelmshaven and Hamburg respectively.

The two battleships actually laid down in Germany during the period under review, viz., the *Württemberg* and *Ersatz Kaiser Wilhelm der Grosse*, call for little notice, since they were respectively the fourth and fifth units of the well-known *Bayern* class, comprising the nameship, the *Baden* and the *Sachsen*. These vessels are often referred to as "copies" of H. M. S. *Queen Elizabeth*, whereas, in fact, the two types have not much in common. Hitting and resisting power, rather than speed, are the essential characteristics of the *Bayerns*. Against the *Queen Elizabeth's* 25 knots, they were designed only for 21 knots, and their lines are altogether different, as the following comparison shows:

	Length overall	Beam	Draught
Queen Elizabeth	643¾ ft.	90½ ft.	30½ ft.
Bayern	623 ft.	99¾ ft.	28½ ft.

The *Bayern* also carried from 2000 to 2500 tons of additional armor, and her internal protection was on a scale elaborate even when judged by the German standard, which is very high indeed. Her 15-inch guns were of greater power—45 calibers, compared with 42 calibers in the British ship—and were served by special machinery which permitted an exceptionally high rate of fire. These ships are no less remarkable by reason of their horizontal protection against trajectory fire. The *Bayern* herself was scuttled at Scapa Flow in June, 1916. Her sister, the *Baden*, escaped the same fate, thanks to the smart work of the British salvage officers, who succeeded in raising the ship from the shallow water in which she had settled down. Having been allotted to this country by the Allied Naval Council, the *Baden*, it is understood, will be expended as a target ship for the Atlantic Fleet some time this year. The *Sachsen* and *Württemberg* were launched during the war, but not completed; and the fifth ship, *Ersatz Kaiser Wilhelm der Grosse*, never progressed beyond the framing stage. The *Technische Rundschau* some months ago mentioned that the new German battleships intended to follow the *Bayerns* were to have mounted ten 15-inch or "eight guns of still larger caliber, the advantages of the heaviest artillery having been at that time fully appreciated in German naval circles."

On the outbreak of the war the only armored vessel being built in Germany to foreign order was the Greek battleship *Salamis*. In 1912 the contract for this ship had been secured by the Vulkan Company, thanks in large measure to the energetic support of the German diplomatic representative at Athens, and the keel was laid at Hamburg on July 23rd, 1913. The dimensions, etc., were as follows:—Length, 570 feet 9 inches; beam, 82 feet; draught, 25 feet 3 inches; displacement, 19,500 tons. Machinery: Curtis-A. E. G. turbines of 40,000-shaft horsepower; speed 23 knots. Armament: Eight 14-inch 45-caliber guns, twelve 6-inch and twelve 12-pounder quick-fires, three torpedo tubes submerged. The contract for the armament was secured by the Bethlehem Steel Company, but the war supervened before delivery could be made, and eventually the eight

14-inch guns manufactured for the *Salamis* were purchased by the British Government and used to arm four monitors—*Abercrombie, Havelock, Raglan and Roberts.* It was naturally assumed that Germany would complete the *Salamis* for duty with her own fleet, but she did not do so. Launched on November 11, 1914, the vessel was towed to Kiel, and was there employed as a floating barrack. Whatever her ultimate fate, it is improbable that she will be completed as a ship of war.

A very considerable programme of light cruiser construction was undertaken in Germany during the war period, 16 vessels of this type having been laid down since August, 1914, though not all were completed. There were, in addition, six light cruisers already being built or completed for sea, viz., *Regensburg, Graudenz, Frankfurt, Wiesbaden, Pillau* and *Elbing*—the two last-named being Russian vessels being built by Schichau, at Danzig, and confiscated for the German Navy when mobilization was proclaimed. In common with all previous German light cruisers, the *Regensburg* and *Graudenz* carried nothing heavier than the 4.1-inch gun, 12 of which were mounted in each ship. But in the following year, after the first engagements at sea had demonstrated the inadequacy of that weapon, the armament was changed to seven 5.9-inch guns, and at or about the same time several of the earlier light cruisers were also re-armed with weapons of that caliber. It is of interest to note that the first German light cruisers originally designed to mount 5.9-inch guns were the *Frankfurt* and *Wiesbaden,* built under the 1913-14 programme. Moreover, these two ships were the largest light cruisers ever completed in Germany, a somewhat smaller design having been adopted for those laid down in 1914 and subsequently. The *Frankfurt* was 465 feet in length, 45½-foot beam, 17-foot draught, and displaced 5120 tons. Her speed was 28 knots, and the main armament eight 5.9-inch guns. Her sister ship, *Wiesbaden,* was sunk in the Battle of Jutland, after having put up a very gallant fight, to which the British despatches paid generous tribute. The *Pillau* and *Elbing,* as completed for the German Navy, displaced 4320 tons, and had turbines of 27,400-shaft horsepower, giving a speed of 27.5 knots. Their steaming endurance at 10 knots was 6600 nautical miles, and they mounted the same armament as the *Wiesbaden.* The *Karlsruhe* and *Königsberg*—both named after vessels lost early in the war—although laid down after the outbreak of war, had been authorized under the normal 1914-15 programme. Their dimensions, etc., which became more or less a standard for the majority of the war-built cruisers, were as follows: Length, 450 feet; beam, 43 feet 6 inches; draft, 16 feet; displacement, 4200 tons; speed, 28.5 knots; fuel, 1240 tons coal, 500 tons oil; armament, eight 5.9-inch, two or three 22-pounder A. A. guns, two deck and two submerged 19.7-inch torpedo tubes. Of this class, besides the *Karlsruhe* and *Königsberg,* there were actually built: *Emden, Nürnberg, Köln, Dresden;* and of the eight cruisers being built, but incomplete at the date of the Armistice, four at least are understood to have been of the *Karlsruhe* class. Owing to the disposition of their 5.9-inch guns, these vessels were able to train four guns ahead or astern, and were thus superior in end-on fire to contemporary British cruisers. On the other hand, the great weight of armament at the bows caused the German ships to pitch violently in rough weather, and from all accounts they were indifferent seaboats.

At the beginning of 1915—that is, before the first mine-laying submarines had been completed and when the value of underwater craft for this work was still problematical—the Germans designed two light cruisers of a new type for the special duty of long-distance mining operations. Both vessels, *Brummer* and *Bremse,* were assigned to the Vulkan Yard, Stettin, and completed respectively in March and July, 1916—or in little more than 12 months from the laying of the keels. This was creditable achievement in view of the dimensions of the vessels:—Length, 430 feet; beam, 41 feet; draught, 15 feet 6 inches; displacement, 4000 tons.

Turbine machinery originally built for a Russian contract was appropriated for these ships, each of which had engines of 46,000-shaft horsepower for a speed of 30 knots. Their bunker capacity of 550 tons of coal and 1190 tons of oil fuel gave them a very extended cruising radius. They were armed with four 5.9-inch guns on the center line, two 22-pounder A. A. guns and four torpedo tubes, and provision was made for carrying 300 mines. The scantlings were extremely light, and the structure of the hull bore traces of hasty workmanship. It is now known that an attempt was made to give these ships the outward appearance of British light cruisers, as they were intended to operate in enemy waters, but when completed they bore no marked resemblance to any British ship, and when they raided the Scandinavian convoy in October, 1917, their identity as German cruisers was easily established at the limit of visibility. On that occasion, it will be recalled, sank the destroyers *Mary Rose* and *Strongbow* and a number of neutral merchantmen. This was the only successful enterprise which the *Brummer* and *Bremse* appear to have carried out, and there is reason to believe that their general structure and machinery proved too fragile to stand the strain of North Sea campaigning.

Two light cruisers, *Ersatz Emden* and *Ersatz Köln*, begun in 1917 at Kiel and Bremen respectively, but abandoned before launch, are reported to have been of an exceptionally large and powerful type, primarily intended for commerce destruction. They were to have displaced between 7000 and 8000 tons, with a sea speed of 30 knots, and the armament was to have included several heavy guns, probably 8.2-inch. It is not to be doubted that raiders of this type would have been a formidable menace. The appearance of even one or two on the trade routes must have led to a drastic revision of our convoy arrangements, necessitating the addition of cruisers sufficiently fast and powerful to deal with the newcomers. In the latter part of 1914 the bare rumor of a contemplated cruiser attack on the Canadian convoy impelled the Admiralty to detach a battle-cruiser from the Grand Fleet. It will be seen, therefore, that the Germans missed a great opportunity of playing havoc with our naval dispositions, and perhaps of seriously weakening the one force that stood between them and the attainment of their war aims—The Grand Fleet. From the technical standpoint, their light cruisers of the war period exhibit no remarkable features. Geared turbines, first introduced in the *Karlsruhe*, of 1913, were gradually adopted for nearly every type of ship. Alive as they were to the benefits of oil fuel, the Germans were in the unfortunate position of being unable to take full advantage of it, owing to the uncertainty of supply. Consequently, only the destroyers were built on a purely oil-fired basis, and—as we shall see later—at one period of the war the oil supply ran so short that the advisability of reverting to coal-burning boilers for these boats was seriously considered. All the capital ships and light cruisers completed within the period under review were equipped with two types of boilers, one type for solid and the other for liquid fuel. In the battleships the percentage of oil-fired boilers in the total generating plant was 42 per cent; in the battle-cruisers, 45 per cent, and in the light cruisers, 52 per cent. An exception was made in the case of *Brummer* and *Bremse*, the majority of the boilers of which were fired with oil. The capital ships projected, but never completed, were to have had 70 per cent of their generating plant fired with oil. Throughout the war the steaming efficiency of larger German warships was impaired by the indifferent quality of the coal supplied, and to that factor must be attributed, at least in part, the poor speed of their battle-cruisers at Jutland. The trouble was mitigated to some extent by introducing a system of water-cooled firebars, but this, of course, reacted on the thermal efficiency of the boiler, and towards the close of the war an improved method of air cooling was adopted.

As mentioned above, the decision to mount 5.9-inch guns, firing a 101-pound projectile, in place of the 4.1-inch 35-pounder, as the main armament

of light cruisers had been come to before the war. German naval critics now admit that the retention of the 4.1-inch gun for so long was a grave error of judgment. With regard to the general design and construction of light cruisers, Great Britain may safely claim to have held the lead before and during the war. The protection of our ships, both above and below water, was remarkably good, and they proved better able to withstand punishment from gunfire and torpedoes than their German contemporaries.—*The Engineer,* June 4, 1920.

GERMAN NAVAL CONSTRUCTION, 1914-1918.—*No. II.*—Before the war the German torpedo service enjoyed an exceedingly high reputation, and was considered by many authorities to be the most efficient organization of its kind in the world. Even in the British Navy there were officers who believed the Germans to be ahead of us in the design of boats and the training of personnel in torpedo tactics. This view was not confirmed by war experience, and we may recall with pardonable satisfaction that it was traversed by an article published in *The Engineer* some months before the outbreak of hostilities, in which the characteristics of each group of German destroyers—or "Grosse Torpedoboote," to use the official designation—were examined and criticised in some detail. The truth appears to be that the development of the torpedo service had been influenced by the same erroneous conceptions of sea strategy that stultified German naval policy throughout the war. The evidence of such competent witnesses as Grand Admiral von Tirpitz and Admiral Scheer proves that those who were responsible for the creation and direction of Germany's naval forces had so far misread history as to infer that the British Navy, in the event of war, would forthwith proceed to dash itself to pieces against the German coast. Every preparation had been made for this contingency. The approaches to the coast were guarded by formidable batteries, for the cost of which an extra squadron of battleships might have been built; and the matériel of the German fleet was designed with a special view to fighting under the lee, as it were, of the German coast. All the heavy ships were built primarily as floating fortresses, so armored and otherwise protected as to be practically unsinkable; but with a limited sea endurance and only makeshift accommodation for the crews, who were expected to spend most of their time in barracks ashore. As for the destroyers, this term was truly a misnomer when applied to the German craft; the official label of "large torpedo-boats" described them with greater accuracy. They were well-built, fast and weatherly boats, carrying a heavy armament of torpedo tubes, but signally deficient in gun power. But in the German scheme of torpedo tactics the gun counted for very little. By daylight the boats were intended to work with the battle-fleet or with light cruisers, under the cover of whose guns they would fire torpedoes at long range against the enemy's line; whilst in the hours of darkness they would deliver torpedo attacks at short range, trusting to their invisibility and speed to make good their escape. It did not seem, therefore, that any useful purpose would be served by giving them a powerful armament of guns. In harmony with these principles, the majority of the boats ordered before the war mounted nothing heavier than the 3.4 inch gun. But at a very early period of the struggle the Germans found reason to modify their appreciation of destroyer functions. It was, as they discovered, not always possible to employ these boats in conjunction with heavy ships and cruisers, and when left to face unsupported the superior armament of British and Russian destroyers they were generally worsted. This was geschütz," a 3.4-inch model of 30 calibers, with a muzzle energy of only 485 foot-tons and a maximum range of 8000 yards. An improved model of the same caliber had been complete in 1912 or 1913, and was mounted in the boats of the normal 1913-1914 programmes. This was 45 calibers in length, and had a semi-automatic breech-block which materially acceler-

ated the rate of fire. It discharged the 22-pound high-explosive projectile and was therefore but little behind the British 4 inch 25-pounder in destructive effect. The boats in question had three of these improved guns mounted on the center line. The 4.1 inch model, which subsequently became the standard armament in German destroyers, was first introduced in four boats, *G 41* and *42* and *V 47* and *48,* ordered in April, 1914. With a length of 45 calibers and mounted on a special carriage which permitted almost vertical elevation, it could be used either for flat trajectory or anti-aircraft fire, and was remarkably accurate up to 12,000 yards. The shell used weighed 38½ pounds. Our reply to this formidable weapon was the 4.7 inch gun, with which our later flotilla leaders and the second group of "*Admiralty V's*" are armed. But the Germans meanwhile were preparing to "go one better." In the summer of 1916—that is, after the Battle of Jutland, in which there had been a great deal of destroyer fighting at close range and weight of gunfire proved decisive—they produced a new type of destroyer, the principal feature of which was a gun armament of extraordinary power. These 12 boats, each mounting four 5.9 inch guns, will be described later, but their armament alone indicates the revolution which less than two years of war experience had brought about in the original German theory of torpedo-boat tactics.

Before proceeding to tabulate the successive groups of "large torpedo-boats" completed during the war a few words may be said about the characteristics common to all German surface torpedo craft. As mentioned above, they were remarkable for great structural strength. A rigid economy in weight was practiced, and every effort was made to keep the profile of the boat as low and inconspicuous as possible. To facilitate quickness in maneuvering, a bow rudder was fitted. This was said to reduce the turning circle by at least 25 per cent. When not in use the bow rudder was withdrawn into a recess to avoid fouling mines or other obstacles. As in the larger vessels, the living quarters were extraordinarily cramped and primitive, and to those who have inspected the surrendered German destroyers, it will always remain a mystery how their crews contrived to live at sea. All but the latest pre-war boats carried four torpedo tubes, two of which, mounted on the center line, could be trained on either beam, while one tube was placed on each side between the break of the forecastle and the bridge. The boats laid down in 1913 were given two pairs of tubes on the center line, bringing the total number of tubes up to six, and this armament was perpetuated in later boats. In the boats of the 1911 and 1912 programmes an attempt was made to reduce displacement without prejudice to other qualities. These 24 craft, *V 1-6*, *G 7-12,* and *S 13-24,* displaced only 560 to 570 tons, and were thus 17 per cent smaller than their immediate predecessors, though with the same armament and speed. The reduction in size was made possible by increasing the proportion of oil fuel to coal in the boiler furnaces; but the boats were not altogether successful, and in 1913 a return was made to larger dimensions. The boats of that year's programme, *V 25-30* and *S 31-36*, embodied several noteworthy improvements. Not only were they armed with three 3.4 inch 45 caliber guns and six 19.7 inch tubes, as compared with two 3.4 inch 30-caliber guns and four 19.7 inch tubes in the preceding type, but for the first time oil-fired boilers were exclusively adopted, an innovation that enabled a nominal speed of 34 knots to be attained. In this class, also, the system of firing all torpedo tubes from the bridge was first introduced, and the artillery control arrangements were greatly improved.

It was with considerable trepidation that the Germans belatedly followed our example in using only oil fuel in their destroyers. They were, of course, fully conscious of its advantages, but the precariousness of supply, especially in time of war, caused them to hesitate before committing themselves to an "all-oil" policy. These misgivings were justified in the course

Number and designation	Length overall, ft.	Beam, ft.	Mean draught, ft.	... displacement, tons	... capacity, Normal / Maximum, tons	... endurance at 20 knots (nautical miles)	Best run S.H.P.	Best run Speed knots	Mean of 6 runs S.H.P.	Mean of 6 runs Speed knots	Armament	Remarks
Six boats: V 25–30	257.6	27.23	8.79	800	90/232	1680	24,300	38.2	22,260	36.8	3 3.4in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered April, 1913. First boats delivered in 7¾ months.
Six boats: S 31–36	261.16	27.23	7.84	790	90/220	1250	22,180	34.9	22,180	34.7	3 3.4in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered April, 1913. First boats delivered in 12 months.
Four boats: G 37–40	261.16	27.23	8.89	872	110/298	1685	25,800	35.12	25,000	34.4	3 3.4in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered April, 1914. First boats delivered in 14 months.
Two boats: G 41–42	272.31	27.23	9.05	960	166/325	1715	25,000	34.6	25,000	34.18	3 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered April, 1914. First boats delivered in 17 months.
Four boats: V 43–46	261.16	27.23	8.95	831	90/280	1750	25,400	37.5	24,660	36.91	3 3.4in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered April, 1914. First boats delivered in 9½ months.
Two boats: V 47–48	272.64	27.23	9.31	948	179/338	1985	23,850	35.3	22,940	34.87	3 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered April, 1914. First boats delivered in 12¾ months.
Four boats: S 49–52	261.16	27.23	7.84	790	90/251	1345	24,610	37.1	24,610	36.36	3 3.4in. 45 cal. 6 19.7in. tubes 24 mines.	First war boats. Ordered Aug. 6, 1914. Delivered in 10 months.
Fourteen boats: S 53–66	273.39	27.23	8.30	905	162/305	1960	25,013	35.7	25,000	35.13	3 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered Aug. 6, 1914. First boats delivered in 8 months.
Eighteen boats: V 67–84	269.01	27.23	9.21	950	160/317	1810	22,600	36.6	22,600	34.35	3 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered Aug. 6, 1914. First boats delivered in 9 months.
Twelve boats: G 85–96	272.31	27.23	9.05	956	166/325	1960	26,300	34.2	26,100	33.72	3 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered Aug. 6, 1914. First boats delivered in 14½ months.
Six boats: V 125–130	269.03	27.23	9.15	907	167/330	1695	25,500	34.68	25,150	34.63	3 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered June 28, 1916. First boats delivered in 8¾ months.
Nine boats: S 131–139	272.31	27.26	8.36	910	162/305	1530	24,000	34.61	23,800	33.74	3 4.1in. 45 cal. 6 19.7in. tubes No mines.	Ordered July 15, 1916. First boats delivered in 8 months.
Two boats: H 145–146	279.86	27.39	9.31	990	166/332	1840	23,788	33.56	23,800	33.33	3 4.1in. 45 cal. 6 19.7in. tubes No mines.	Ordered Nov. 15, 1916. First boat delivered in 16 months.
Six boats: B 97–98, 109–112*	321.53	30.67	9.38	1354	150/526	2620	40,800	38.09	40,217	37.51	4 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered Aug.–Oct., 1914. First boats delivered in 4¾ to 5 months.
Two boats: V 99–100*	324.81	30.71	9.22	1313	150/518	2250	42,850	37.85	40,475	37.67	4 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ordered Aug. 10, 1914. Delivered in 7¾ months.
Four boats: G 101–104	312.67	30.18	9.05	1198	150/409	2420	29,400	33.72	28,650	32.96	4 4.1in. 45 cal. 6 19.7in. tubes 24 mines.	Ex-Argentine boats. Modified to German design, Aug., 1914. Built in 15 months.
Twelve boats: S 113–115, V 116–118, G 119–121, B 122–124	360 30	36.23	13.04	2400 2485	210/720	3200 (?)	56,000	36.9	54,000	35.30	4 5.9in. 40 cal. 4 23.6in. tubes No mines.	Ordered July–Aug., 1916. First delivered May, 1918. Proved unseaworthy on trial. None

of the war, for at one time, when no less than 84 destroyers with oil-fired boilers were under construction, the supplies from Galicia and Roumania threatened to cease entirely. Stocks were low at this time, and the position was rendered still more critical by the rapidly increasing consumption of oil by the submarine flotilla. So serious, indeed, was the outlook, that a decision was reached to reconvert all destroyers then under construction back to a coal-burning basis, a measure which naturally caused great delay in their completion, involving as it did drastic alterations in structure. Eventually, however, the reserve of oil was enlarged by increased production from domestic sources and by the use of German tar oil, expedients which enabled the 84 boats to be completed to the original oil-burning design though the contract date of delivery was exceeded in every case. As the war proceeded it was found that boats of the pre-war dimensions were not sufficiently large to perform the multifarious and exacting duties that devolved upon them. Their cruising endurance proved to be inadequate, and in heavy weather their speed was so reduced that they could not keep pace with the heavy ships. Moreover, there was an insistent demand for a better armament of guns, torpedo tubes and mines, which could not be met without a large jump in displacement. To meet these various requirements a number of boats in an early stage of construction were cut in half and lengthened on the slip. Throughout the war improvements were continually made in the fighting equipment of the boats, culminating at length in an elaborate system of control for guns and tubes, the installation of electric range transmitters, training pointers, long-base telemeters, etc. A certain number of boats, specially detailed for anti-submarine work, were fitted with explosive sweeps, and others with a German adaptation of the paravane for mine clearance. In the later stages of the war, all mine-laying on the German side was done by submarines, and mines and laying gear had been removed from the destroyers. It must be remembered that after the first year of hostilities the pressure of the blockade began to make itself felt in every branch of German industry. Shipbuilding of every description was hampered by ever-growing difficulties, due both to shortage of materials and to the reduced efficiency of the workers. From the summer of 1915 onward the acute scarcity of copper and tin left the builders no alternative but to use iron extensively in the construction of destroyers, the increased weight of which had, of course, a prejudicial effect on speed. In the penultimate year of the war, after many fruitless attempts had been made to design boats embodying all the requisite qualities of speed, seaworthiness, armament, etc., in a small displacement, plans were got out for a standard type of destroyer, about 40 of which were ordered during 1917. This type was to be of 1500 tons—*i. e.*, nearly twice the weight of the typical pre-war boat—and to have a speed of 36 to 37 knots. Of these boats, which differed from earlier types in that they were to have been equipped with geared turbines, none was complete at the date of the armistice, and all have since been dismantled.

In addition to destroyers, nearly 120 small torpedo-boats for coastal work were ordered during the war. They were know as "A" boats, and were divided into three classes, I, II, and III, according to their displacement and date of design. Practically all the important shipbuilding yards in Germany were employed on destroyer and torpedo-boat construction in the war period, and to the three establishments which formerly specialized in this work, viz., Schichau (Elbing), Krupp-Germania (Kiel), and Vulkan (Stettin and Hamburg), were added the Blohm and Voss (Hamburg), Howaldt (Kiel), Weser (Bremen), Lübecker Maschinenbau-A. G. (Lubeck), and Nobiskrug (Rendsburg) yards, all of which built hulls as well as machinery. One or more destroyers of a large type were laid down at the Wilhelmshaven dockyard. In the same way contracts for the hulls, machinery and fittings of the "A" torpedo boats were distributed among many firms. It is interesting to note that boats of the A I and A II classes

TABLE II.—(GERMAN TORPEDO BOATS COMPLETED DURING THE WAR)

Number and designation	Length overall, ft.	Beam, ft.	Mean draught, ft.	Normal displacement, tons	Oil capacity, Normal/Maximum, tons	Maximum endurance at 20 knots (nautical miles)	Trial results: Best run. S.H.P.	Trial results: Best run. Speed, knots	Trial results: Mean of six runs. S.H.P.	Trial results: Mean of six runs. Speed, knots	Armament	Remarks
A I. Class—Twenty-five boats: A I 25	136.32	15.09	4.13	107	—/23.8	440 (at 19 kts.)	1125	20	1084	18	1 4-pr. 2 17.7in tubes 4 mines	Ordered Sept., 1914 First boats delivered in 3 months
A II. Class—Twenty-four boats: A 26–49	164.37	17.45	6.04	228	45/53	975	3500	26.3	3300	25.8	2 3.4in. 30 cal. 1 17.7in. tube	Ordered Dec., 1915 First boats delivered in 6 months
Six boats: A 50–55	164.37	18.44	6.03	229	45/55	840	3500	25.7	3300	24.7	2 3.4in. 30 cal. 1 17.7in. tube	Ordered July, 1916 First boats delivered in 4½ months
A III. Class—Twenty boats: A 56–66, A 80–82, A 86–91	196.85	21.03	5.90	329	85/91	805	6050	28.38	5960	25.39	2 3.4in. 30 cal. 1 17.7in. tube	Ordered July, 1916, March, July, 1917 Built in 5½ months
Sixteen boats: A 68–79, A 92–95	196.92	21.06	6.26	354	76/82	725	5800	27.01	5800	26.2	2 3.4in. 30 cal. 1 17.7in. tube	Ordered July, 1916 and July, 1917 Built in 5½ to 6 months
Four boats: V 105–108	200.13	20.37	6.36	349	30/59 coal 5/16 oil	640	6000	30.01	5905	29.96	3 3.4in. 45 cal. 3 17.7in. tubes 12 mines	Originally begun for Holland. Appropriated Aug. 10th, 1914. Built in 12 months.

were built in sections, railed to distant bases, such as Bruges and Pola, and reassembled there.

Immediately after mobilization had been proclaimed, contracts were placed for 48 destroyers of the so-called "*Ms*" type (Ms=mobilization). From that date to August 1, 1918, a further 264 destroyers and coastal torpedo-boats were ordered, bringing the total number of surface torpedo craft ordered during the war period to 312, with an aggregate of 299,457 tons. Owing, however, to various delays resulting from causes mentioned above, little more than half this programme had been completed when the armistice supervened, the deliveries to that date being 197 boats of 147,910 tons. The number of boats ordered from and the number actually delivered by the various yards is given in the following table:

	War contracts		Deliveries	
	Boats	Tons	Boats	Tons
Blohm and Voss	9 of	18,129	6 of	10,740
Germania Yard	28 of	37,834	22 of	27,046
Howaldt Yard	27 of	35,819	2 of	2,266
Schichau Yard	109 of	95,781	79 of	49,362
Vulkan Yards	138 of	110,761	88 of	58,505

Included in the above totals are four large destroyers which at the outbreak of war were being built at the Germania yard, Kiel, for the Argentine Government, and four torpedo-boats being built at the Vulkan yard for the Netherlands Navy. These vessels were at once appropriated for the German service.

The trial results given in the tables are not a fair indication of the sea speeds actually attained by German destroyers completed during the war. Owing to the vigilance of our submarines and the activity of our minelayers, the waters of Heligoland Bight soon became too dangerous for steam trials, the venue of which had to be transferred in the third month of the war to the western Baltic, where the shoal water is unfavorable to speed trials under practical conditions.

As will be seen from Tables I and II every German destroyer completed within the period under review mounted the standard torpedo armament of six tubes. In the case of the two sets of twin tubes on the center line, the axes of each pair were so fixed that the forward ends of the tubes diverged at an angle of 15 degrees. This arrangement was the outcome of experience, which showed that when two torpedoes were discharged simultaneously from a pair of tubes mounted in parallel, the practice was not so accurate as when two torpedoes were fired in succession. The angle of divergence of the tube axes was determined by careful experiment, and was considered to offer the best chance of hitting, both at short and long ranges. There can be no question as to the all-round efficiency of German torpedoes. The standard torpedo for use in destroyers was the "G 7" 50 cm. (19.7 inch) steam heater model, with a length of 7 m. (22.97 feet), and a warhead containing 430 pounds of explosive. This weapon had a range of 5500 yards at 35 knots speed, and of 11,700 yards at 28 knots. A smaller model, the 45 cm. (17.7 inch) bronze torpedo, with a charge of 198 pounds of guncotton, was employed by the earlier torpedo craft, and it was with this weapon that the Submarine *U-9* was armed when it sank the three "*Cressys*." An improved 45 cm. torpedo produced during the war contained a charge of no less than 330 pounds of explosive, consisting of T. N. T. blended with "Hexa," a mixture * said to be 30 per cent more powerful than wet guncotton. But effective as the 17.7 inch and 19.7 inch torpedoes proved to be against most targets, a still more destructive charge was needed to overcome the minute subdivision of the modern

* This mixture was known as "Hexanitrodyphenylsulphide," and was credited with an explosive energy 10 per cent greater than that of T. N. T.

dreadnought, and for this purpose the Germans, in 1914, designed a 60 cm. (23.6 inch) torpedo, with a warhead of 550 pounds. This formidable engine had the enormous range of 16,000 yards, which it could traverse at a speed of 28 knots. The first vessel to be equipped with 23.6 inch torpedo tubes was the battle-cruiser *Lützow*, sunk at Jutland, and similar tubes were fitted in the "*Bayern*" class of battleships. Four tubes of 23.6 inch caliber were also mounted in the 12 huge "destroyers," or flotilla leaders, of the *S-113* type. It need hardly be said that the heavy demand for torpedoes throughout the war led to a corresponding expansion of German manufacturing facilities. In 1913, the last peace year, a total of 193 torpedoes was delivered, as compared with 774 in the month of September, 1918. In less than five years, therefore, the annual output had increased forty-eightfold.

The 12 vessels of the *S 113* type, displacing as they did nearly 2500 tons, were the largest surface torpedo craft in the world. Their nearest rivals in point of size are *H. M. S. Swift*, 2207 tons, and the new Italian leaders of the "*Leone*" class, 2200 tons; but in weight of armament the German boats were far superior. Their four 5.9 inch 40-caliber guns—on mountings which enabled them to be used against aircraft—were disposed on the center line: one on the forecastle, one abaft the second funnel, and two at the stern, the third gun superfiring over the fourth. By this arrangement four guns could fire on either broadside, one ahead, and two astern. To operate the two pairs of ponderous 23.6 inch tubes, which

TABLE III.—COMPARATIVE TABLE OF BRITISH AND GERMAN DESTROYERS

	British "M" class	German S 53-66	British "V" class	German B 97-98	British Bruce	German S 113
Length, feet	271½	273	312	321½	332½	360
Beam, feet	26⅔	27½	29½	30⅔	31¾	36½
Draught, feet	8⅔	8½	9	9⅝	10½	13
Displacement, tons	1,025	905	1,300	1,354	1,801	2,485
Shaft horse-power	25,000	25,000	27,000	40,200	40,000	54,000
Speed, knots*	34	35	34	37½	36½	35
Oil fuel, tons	225/270 (average)	162/305	320/370	150/526	450/500	210/720
Armament	3 4 in. guns 4 21 in. tubes	3 4.1 in. guns 6 19.7 in. tubes	4 4 in. guns 4 21 in. tubes	4 4.1 in. guns 6 19.7 in. tubes	5 4.7 in. guns 6 21 in. tubes	4 5.9 in. guns 4 23.6 in. tubes
Weight of broadside (gunfire), lb.	75	115½	100	154	225	404

* It should be noted that whereas for the British boats the designed speed is given, the German figure represents the speed attained on trial. It is well known that British war-built destroyers almost invariably exceeded their designed speeds in some cases by as much as three or four knots.

were 32 feet in length, electric motors were fitted and there was a very elaborate system of fire control for the gun and torpedo armament, including a director station above the bridge. It is, however, significant that none of the twelve vessels was ever actually commissioned, though several were completed in May, 1918. Very probably they turned out to be unseaworthy, owing to the excessive weight of armament, and it is certain that the actual fighting value of the type would have proved considerably less than its characteristics suggest. It is no easy matter to handle projectiles of 101 pounds weight on the slippery deck of a destroyer, and in a seaway the rate of fire from the 5.9 inch guns must have been very slow. Still, the type deserves notice as an example of the remarkable qualities of offence which may be incorporated in a vessel of high speed and modest displacement.

In conclusion, it is instructive to compare as in Table III some British and German destroyers built during the war. Unfortunately, the steaming endurance of the British boats cannot be ascertained, but is indicated to some extent by the fuel capacity.—*The Engineer,* June 25, 1920.

GREAT BRITAIN

THE ENGINEERING BRANCH OF THE NAVY.—In the course of our leading article on the most notable events of Lord Fisher's career at the Admiralty, we alluded to the scheme of common entry and training for naval officers up to the stage when specialization in deck or engineering duties began, and pointed out that despite certain modifications which had been introduced subsequent to its adoption in 1902, fundamentally the system was still unchanged. Since we wrote on this subject, the Admiralty has given notice of a further revision which it had decided to make in regard to the position of officers who specialize in engineering duties. Some such measure was clearly foreshadowed in the First Lord's statement on Admiralty policy issued last March, in which document the necessity for a final separation between the deck and engineer officers of the naval service was emphasized. One passage in the statement read as follows: "There is a definite distinction both as regards knowledge and capabilities between those who are to be trained in the science of naval war and strategical and tactical methods of fighting, and those who are to deal with the upkeep and maintenance of engineering and mechanical appliances which are necessitated by the complex machinery and weapons of modern war. Each side requires a special study, and for this reason final separation of the branches is essential." At the same time stress was laid on the importance of close co-operation between the deck and engineering branches. In its latest memorandum, the Admiralty summarizes the measures by which it proposes to effect this separation without prejudicing the high standard of efficiency that characterizes the *personnel* of each branch. So far as the deck side is concerned, the maintenance of such a standard may be said to be assured by the prospects of high command that lie before all officers who specialize in deck duties. On the engineering side, however, these attractions have not hitherto existed in equal measure; for, excepting the post of Engineer-in-Chief, and certain technical appointments, the higher offices open to engineers have been relatively few in number. As the Admiralty frankly recognizes, there is consequently "a danger that under existing conditions the engineering side may fail to attract its due proportion of officers of ability, and the service will suffer in efficiency accordingly." Among the several steps that are to be taken to avert this contingency, the first consists in raising the status and enlarging the province of the department of the Engineer-in-Chief. While this officer will continue, as at present, to be responsible for the design and supply of engineering material, and in this capacity remain subordinate to the Third Sea Lord and Controller, he is now to become principal adviser to the Chief of the Naval Staff on all matters concerning naval engineering policy. This means that in future he will work in intimate touch with the Naval Staff, and be closely informed as to the trend of naval policy, thus enabling him to frame his engineering plans to harmonize with the requirements of policy. Nor is this the only important extension that the duties of the Engineer-in-Chief are to undergo. Henceforth he will be the Board of Admiralty's principal adviser upon all questions relating to the teaching and training of engineering *personnel,* for which work he will be responsible to the Board through the Second Sea Lord. Owing to the new functions about to devolve upon it, the department of the Engineer-in-Chief will increase very considerably in size and importance, and thus provide scope for the appointment of senior engineer officers to posts of high administrative importance and responsibility. A further avenue of preferment is to be opened up by making engineer officers eligible to serve as Admiral Superin-

tendents of the Royal Dockyards. Until now these posts have been filled exclusively by deck officers, but under the new rule engineer officers who have attained the necessary rank are to enjoy an equal chance for such appointments, with the reservation that an engineer officer who may be serving as an Admiral Superintendent will not be eligible to command the port, since port command in war time deals with operations which are to remain the province of the deck officer alone.

To render more complete the separation of the two branches, the Admiralty has decided to cancel the rule under which lieutenants with a year's experience of watch-keeping to their credit before they specialized in engineering are allowed the option of reverting to deck duty between seven and a half and nine years' seniority. This modification is less drastic than might appear, since a very large majority of engineering specialists had already renounced the above option by accepting the Admiralty regulations promulgated in 1918—*vide* Monthly Order 4047 of that year—and the amendments notified in the following year. Of more importance is the impending decision of the board with respect to future responsibility for the maintenance of electrical machinery in H. M. ships. This responsibility rests at present upon the torpedo department, but a committee is now sitting to consider the question of transferring it to the engineering department. That this matter calls for careful investigation will be appreciated by all who are familiar with the multifarious duties—some directly bound up with the efficiency of the ship's torpedo armament, others bearing no direct relation to torpedo work proper—now discharged by the torpedo specialist and his staff. In our view, the transfer of many of these duties to the engineering department would be advantageous to the service by tending to simplify the organization on board and doing away with the overlapping of work which becomes inevitable under the arrangement now in force. At the same time, as the Admiralty memorandum points out, the change would open up further positions both in the junior and higher ranks to officers who have chosen an engineering career in the navy.

Taken as a whole, the reforms outlined in the memorandum impress us as representing a decided change for the better in the prospects of naval engineer officers. We especially welcome the improvement in the status of the Engineer-in-Chief and his department as a sign that the present board realizes more clearly than some of its predecessors did the vitally essential part that the engineer plays in modern naval organization. At no period in the history of naval development was there a greater need than exists to-day for the closest relationship between the Admiralty and its engineering advisers. Our future policy, as regards *matériel,* will be largely determined by the progress of engineering, with which only the specialist can keep fully abreast, and the fact that from now on the Engineer-in-Chief is to work in direct co-operation with the Naval Staff is an assurance that the British Navy will not lag behind its competitors in technical progress or technical efficiency. As for the separation of the two branches, deck and engineering, the majority of engineers, both within and without the service, will, we think, regard the Admiralty's decision as a sound one; but an examination of the principles on which it is based must be deferred to a subsequent occasion.—*The Engineer,* July 23, 1920.

NAVAL STAFFS AFLOAT.—It is interesting, as one of the signs of the influence of the war upon the internal economy of our ships, to notice the very large increase in the numbers of staff officers carried in flag-ships. If we go back 20 years, to the staff which was in the *Renown* when vice-Admiral Sir John Fisher, as he then was, flew his flag in her as Commander-in-Chief in the Mediterranean, it will be found that this numbered ten officers all told, including seven clerks. Fifteen years ago a staff of 13 was

all that Admiral Air Arthur Wilson had in the *Exmouth* when he was Commander-in-Chief of the Channel Fleet. At the present time, there are in the *Queen Elizabeth* 32 officers of all grades on the staff of the Commander-in-Chief of the Atlantic fleet; and the flagship in the Mediterranean, the *Iron Duke,* surpasses this with a total of 40 officers on the Commander-in-Chief's staff, although it seems fairly obvious that not all of them can be employed afloat. There are representatives on an Admiral's staff nowadays of every conceivable branch or duty, a fleet torpedo officer, gunnery officer, wireless officer, war staff officer, political officer, intelligence officer, signal officer, more than one engineer officer, a royal marine officer, accountant officer, and medical officer. A cynic of the old school of seamen might well ask what there is left for the Admiral to do. At any rate, it is a good thing that the size of ships continues to increase or there would not be room to stow away all the members of the staff.—*The Army & Navy Gazette,* July 24, 1920.

LIGHT CRUISER DESIGN.—With the recent launch of the *Emerald* on the Tyne, all the light cruisers ordered for the navy during the war have now been put afloat, with the one exception of the *Effingham* at Portsmouth. The *Emerald,* and her sistership the *Enterprise,* now at Devonport Dockyard awaiting completion, belong to a class which did not appear in any of the lists of ships during the war, and which it was thought had been abandoned after the armistice. The "E" type is, however, so much superior to the eight vessels of the "D" class that from the constructive point of view it is a good thing that two ships of the type should have been spared. The outstanding feature of the *Emerald* will be her speed—from 32 to 33 knots—which will make her quite the fastest cruiser ever designed for our navy, the previous limit of design being 30 knots. At this high rate, moreover, she will carry seven 6-inch guns, or one more than in the "D" class, and will be infinitely superior in armament to the *Arethusa,* with her mixed battery of two 6-inch and six 4-inch guns. As an engineering proposition the design of the *Emerald* must have presented many difficulties. Her tremendous drive of 80,000-horsepower exceeds that of all our battleships, and also of the battle cruiser *Lion;* in fact, only the later battle cruisers in the British, American and Japanese navies have a higher enginepower. For many reasons the design is most interesting, and although progress in construction seems likely to be slow, owing to the need for economy, the trials of such a vessel will be awaited with much keenness.—*The Army and Navy Gazette,* July 10, 1920.

THE SHIPBUILDING SITUATION.—It is becoming more and more evident that the peak of activity in the shipbuilding industry has been reached, both in this country and in the United States. Apart from special types of vessels, such as passenger steamers and ships for the carriage of oil in bulk, there is a very decided falling off in the number of new contracts being placed, and in fact some shipowners are endeavoring to get rid of their shipbuilding commitments. As regards oil-tank steamers, the demand is likely to continue longer owing to the enormous developments taking place in the use of oil fuel, which make it essential that the necessary transport shall be provided in spite of the present high costs. In the United States some alarm is being expressed at the great reduction of cargo-ship contracts reported, although a large increase in the number of oil-tanker contracts has taken place. The American shipbuilders realise that any special type of vessel alone will not enable them to keep their establishments employed for any prolonged period.

The causes of the reduced demand for new tonnage are self-evident. Apart from the falling freight market, the high cost of production and uncertain delivery now make the question of ordering a ship a very doubtful speculation, and with ever-advancing costs of labor and material the

risk involved is so great as to preclude business. One of the most important of the contributing factors to the period of reduced activity foreshadowed is the fact that, owing to the world's increased facilities for shipbuilding, the deficiency in tonnage is rapidly disappearing. Already there is considerably more tonnage afloat than just prior to the war, and it is calculated that at the end of the present year the tonnage in existence will be more than equal to the amount of the pre-war tonnage with the addition of the normal increase for the succeeding years. Mr. Lawrence D. Holt, of the well-known Liverpool shipping company, stated in a recent communication to the press that there was already too much tonnage in existence, but not enough British tonnage to maintain our position in the trading world, and that we must either launch more tonnage into a glutted market or surrender our position in the trading world.

This brings us to the question of cost of production, which is vital to the British shipbuilding industry for the future. The British shipowner will either not be able to compete with foreign owners if the British cost of production is higher than in other countries, or he will be compelled to contract abroad in order to maintain his position. The effect of foreign competition in shipbuilding before the war was becoming evident, and now, in addition, we have the agents of American shipyards in Europe actively competing with us. We have lost the advantage we possessed in our low cost of production, and the struggle for existence in the future is going to be a hard one, especially for the new shipyards which are just commencing operations and which have been laid out at a time of very high cost. Such profits as they will be able to retain after taxation while employment is yet good may possibly not enable them to lay aside reserves to tide over periods of little or no employment.

Ships now cost about four times as much to build as they did before the war, and prominent shipowners are of opinion that at this figure the economic limit at which it will be possible to make a shipping investment profitable in the future has been passed. It is of importance, therefore, to examine cost in relation to the main items of material and labor.

Steel, which is the most important material used in shipbuilding, at present costs four times what it did in 1910, the average price at present being about £25 per ton; and as there are large demands for steel apart from shipbuilding, it is possible that the price may be maintained at a high level in spite of a falling off in the demand for ships. In this respect, United States shipbuilders have now the advantage of cheaper and more abundant steel supplies, and this will be a material help to them in competition with this country. The price of steel is at too high a level, but it is difficult to foresee a reduction in view of the inordinate increase in the cost of fuel and the increased cost of transport. Nevertheless, it is imperatively necessary that there should be a reduction in the cost of steel if the British shipbuilding industry is not to suffer. The cost of ship production has also been greatly augmented by shortage of steel supplies, mainly due to congestion on the railways and the difficulty experienced in the past of obtaining coal for the steel works. This question of short supplies of steel has led to the acquisition of steel works by shipbuilding interests, especially in the Clyde area.

Labor costs in shipbuilding, due to shorter working hours and advances of wages, coupled with a reduction in output per man per hour, have increased out of proportion to the cost of living. Mr. D. B. Morison, chairman of Messrs. Richardsons, Westgarth & Company, Ltd., speaking at the last annual meeting of that company, stated that the actual time now taken to complete a given amount of work was on an average nearly half as long again as before the war. This reduced output, taken in conjunction with the wages' advances and reduction in hours, meant an increase in labor costs of about four times the pre-war figure. Mr. Morison's figures referred to marine engine-building and may be on the high side

so far as shipbuilding is concerned, but the labor cost in shipbuilding has increased at least three-fold.

In spite of the advantages already gained in the way of shorter working hours and increased wages, and encouraged by the facility with which advances have been conceded by the government during the war, and more recently, to other trades, the Federation of Engineering and Shipbuilding Trades has decided to apply for an advance of sixpence per hour, or 23s. 6d. per week, for adult workers, half this amount for boys under 18 years of age, and corresponding increases in piece-work rates. At the same time, the demand for a further reduction of hours to 44 per week is being pressed. The shipbuilding employers at the time of writing have given no indication of the attitude they will adopt with regard to these further demands when they are formally presented, but it is quite evident that neither the shipowning nor shipbuilding industries can stand such huge increases. If such concessions are made as the result of trade-union pressure, it is believed that the result will, in the end, lead to unemployment and prove disastrous. It will be in the best interests of the trade unions themselves if their new demands are declined. Advances of wages which entail still further increases in the cost of living, with the danger of unemployment, are of no benefit to the workers, but these elementary economic facts are recognized by only a handful of the trade-union leaders, whose views are not popular amongst the workmen. A concentrated demand that the cost of living be reduced with the active help of the trade unions, apart from resolutions to that effect which are valueless, would benefit the whole community, and place an international industry like shipbuilding in a stronger position to meet the world competition for work which is inevitable in the near future.—*The Shipbuilder*, July, 1920.

JAPAN

JAPANESE NAVAL PROGRESS.—From the recent debate in the Budget Committee of the Japanese House of Representatives it is possible to obtain a better idea of the program of naval construction which is now being proceeded with by our ally. The Minister for the Navy stated that the present budget includes provision for four dreadnaughts, four battle-cruisers and 12 destroyers and smaller craft. From this it would seem that the only fresh ships to be put in hand are two battle-cruisers. At the beginning of the present year there were already four battleships in hand. Since then the *Mutsu* has been put afloat—on May 31 last—and presumably one of the two projected battleships has been begun on the same slip. As regards battle-cruisers, however, only two were in the program, so that the mention of four during the debate on July 13 implies the authorization of two more. If this is so, it is highly significant that the Japanese should go in for more battle-cruisers in preference to battleships. One reason, however, may be that in 1916-17 an eight-year program was adopted which aimed at the provision of a standard fleet of eight battleships and eight battle-cruisers. At the moment, apart from the two already in hand, the only modern battle-cruisers possessed by Japan are the four of the *Kongo* class, so that two more are necessary to ensure the attainment of the proper standard. In this matter of naval expansion, the Japanese have been very candid; they have concealed nothing about their plans and intentions. A year ago when in London, Admiral Kato said that in Japan they would like to see a general agreement for disarmament, but they had formed no plans yet for a reduction of the navy or army; "we are waiting to see what is done in that way by the other great powers of the world." In the interval, Great Britain has been occupied in drastic reduction of her naval strength by the withdrawal of ships from commission, the sale of several classes of vessels and the dismantling of her naval bases. The same cannot be said of all the other sea powers. Hence the Japanese are

now going ahead with their 1916 plans, which they affirm are not directed against any potential enemy, but dictated by the country's insular position. In view of the renewal of the alliance between Great Britain and Japan, the recent decisions at Tokio are of special interest to this country.—*The Army & Navy Gazette*, July 24, 1920.

BRITAIN TOO PRO-AMERICAN TO SUIT JAPAN.—Grave doubts about the wisdom of continuing the Anglo-Japanese Alliance are expressed in some sections of the Japanese press, where it is felt that the mainspring for its existence no longer exists. Changes wrought by the world-war in the balance of powers and the prospective functioning of the League of Nations are given as reasons for surmises that the alliance has outlived the purpose which it served well. But more acrid criticism comes from those journals that charge Great Britain with having become too much influenced by America during the war and since. Then, too, Australia is accused of having become a political confidant of America because in California America has the same "white-man problem" as has Australia. Above all, resentment is expressed for a suspected interference on the part of America in the possible arrangements for the renewal of the pact. In sharp contrast to this insinuation is a statement of Marquis Okuma issued to the press in Japan in which he calls attention to the public interest the alliance has been eliciting in England, expresses himself in favor of its renewal, and says of America that—

"Because of the Monroe Doctrine, the United States may be unable actually to participate in the alliance to be concluded between Great Britain and Japan; but if such participation should be made possible or should be desired by the American people, America would surely be welcomed into the group so as to form a triple alliance and thus maintain the peace of the Orient with greater efficiency.

"Without the alliance, what about the future of India, and that of China, and that of Siberia? The fact is indisputable that for all the success the British Government has attained so far in the administration of India, there are many malcontents in that country. The fact should be particularly noted that the majority of the inhabitants of northern India are Mohammedans, who are as militaristic as they are religious. Since the fall of the Turkish Empire there has been increasing unrest among them. To make the situation worse, the Bolsheviki are now very active on the borders of both Turkestan and Afghanistan.

"At such a critical period as this nothing could have a worse influence on them than an impression that the Anglo-Japanese alliance is no more and that the Japanese would not interfere whatever might happen in India.

"The same theory may be applied to Japan as regards China and Siberia."

The Tokyo *Kokumin* recalls that when the first Anglo-Japanese Alliance was concluded it was published contrary to the international custom which had hitherto existed. It may be, therefore, that publicity will be given to the new terms if it is renewed, but this journal asserts:

"Other countries have no right to interfere in the negotiations for the renewal. Some Americans have urged that the Paris Conference should be opened to the public and that no secret diplomacy should be tolerated, but this is the twaddle of amateurs who know nothing about diplomacy. As a matter of fact, President Wilson and the diplomatic authorities of America are keeping all diplomatic affairs secret. Even the Anglo-French Alliance or the agreement between Great Britain, France, and America has been withheld from publicity, and this has caused considerable suspicion among the public. No secret treaty is permitted by the League of Nations covenant, but it does not object to the observance of secrecy regarding negotiations under way."

Australia is seen as a confidant of America by the Osaka *Asahi*, which says that the tendency for Australia to rely on America, which is in a position similar to her own, for the realization of her "white-Australia" principle has become clearer of late, and it recites that—

"During the five years of war Japan faithfully observed her obligations under the Anglo-Japanese Alliance, and the Japanese Navy maintained single-handed the safety of communication between Australia and India and Europe, but this has not allayed the Australian misgivings regarding Japan. It may be assumed that the majority of Australians hope for an alliance, or at least some special agreement, between Great Britain and America rather than for the continuance of the Anglo-Japanese Alliance.

"On the other hand, the British Government has become pro-American since the prosperity of Germany became a menace to Great Britain, and that tendency has become more glaring of late. The pro-Americanism of the British Government manifested itself in the conclusion of a treaty of arbitration with America at the time the Anglo-Japanese Alliance had been renewed for the third time. Subsequently the British Government recognized the Monroe Doctrine of America."

It need scarcely be pointed out that during the war and at the Peace Conference, the *Asahi* goes on to say, the British authorities "based their diplomatic policy on pro-Americanism," and it proceeds:

"At a time when there is such a strong pro-American feeling in Great Britain, it is unthinkable that the British Government should arrange for the renewal of the Anglo-Japanese Alliance without taking American wishes into consideration. It also goes without saying that Japanese and American interests are not all identical. . . . .

"In these days an alliance between two countries can not be concluded without the understanding and sympathy of the peoples. It is impossible to make an alliance really effective unless there is community of sentiment and interest between the two peoples, but in many respects there is no such mutuality between Great Britain and Japan. The continuance of the Anglo-Japanese Alliance is not wrong, but an alliance only on paper will lead to a situation similar to Italy's position with regard to the Triple Alliance."

Similarly minded, too, is the Tokyo *Yorodzu*, which admits that the establishment of the League of Nations necessitates modification of the Anglo-Japanese Alliance, but it calls attention to the fact that—

"Some British observers say that the stipulations in the alliance which relate to the territorial integrity of China and other Oriental questions should be extensively revised. If such is the opinion of the British Government, how can the maintenance of peace in the orient and India, which is the main purpose of the alliance, be insured? If the alliance is to be renewed, the renewal should be made in such a way that the document can serve the purpose of locally strengthening the validity of the League of Nations.

"If the British Government intends to reduce the scope of the alliance out of consideration for the sentiment of Australia and other colonies as well as of America, Great Britain should learn that it will be extremely difficult to renew the alliance. On the last occasion the document was renewed as the result of considerable concessions on Japan's part. What attitude will be assumed by the British Government this time? Japan's desire is to insure the peace of the Orient by renewing her alliance with Great Britain. If there is no hope of attaining that end, Japan had better leave everything to the League of Nations. Unless the British and the Japanese people heartily welcome the renewal of the alliance, the document will be merely an assurance on paper and will have no practical value. It is difficult for us to see how it can be advisable to maintain only the name of an alliance."

But the Tokyo *Yomiuri* points out that the fundamental object of the first alliance was to prepare against the southern advance of Russia, but that after the Russo-Japanese War a Russo-Japanese agreement was concluded with regard to South and North Manchuria and Inner and Outer Mongolia, while Great Britain concluded an agreement regarding the borders of India, such as Tibet and Persia. It was no longer necessary, therefore, to place India and Korea on the same footing, which was the primary object of the second alliance, and the *Yomiuri* proceeds:

"The only practical remaining value of the alliance lies in the promotion of common interests in China. Moreover, at the time of the conclusion of the third alliance the fundamental principle of excluding America from its stipulations was laid down. After the Russo-Japanese War, therefore, the Anglo-Japanese Alliance has long since lost the greater portion of its value without waiting for the collapse of Germany and Russia and the establishment of the League of Nations. If the value of the alliance is to be judged solely by its original functions in regard to Russia and by the consideration of the selfish interests of Japan and Great Britain, its necessity has long since disappeared, and there is no need to discuss the question as to whether it should be continued or not.

"Japan and Great Britain, representing the Orient and the Occident, together with America, form the mainstays of the world's peace, and in considering the question of the renewal of their alliance Japan and Great Britain should not confine their attention to the situation in regard to Russia and to their selfish interests alone. They should have a higher object and should be prepared to endeavor to promote the peace and happiness of the world."

As a matter of fact, an opportunity of serving some such purpose was given to the Anglo-Japanese Alliance during the war, this daily goes on to say, as it reminds us that Russia's defeat by Japan in 1905 led to the destruction of the balance of power and increased the influence and ambitions of Germany. Taking advantage of the benefits afforded by her alliance with Japan, Great Britain concentrated in the North Sea the main forces of her fleets from Chinese and Indian waters and in the Pacific, yet this was not sufficient to curb the ambitions of the Kaiser, and the result was the European War. We read then:

"Japan rose up in arms against Germany and rendered the Allies greater assistance than she was obliged to render by the Anglo-Japanese Alliance. While completely sweeping away German influence in the Orient, Japan made great efforts in the Pacific and the Mediterranean in the cause of the Allies. She took part in the Peace Conference, and, as one of the five great powers, she has contributed, together with her ally, to the promotion of the world's peace and the welfare of humanity. She is in a position to continue to render similar services through the League of Nations. Does this not mean that the Anglo-Japanese Alliance has led the two countries beyond the purview originally prescribed for it? If the Japanese and the British are aware of the importance of that point, it will not be difficult for them to overcome dissatisfaction due to selfish considerations, and, as a matter of fact, even dissatisfied observers do not object to the fundamental principle underlying the renewal of the alliance provided that some remedial amendments are made."

The Tokyo *Maiyu* echoes the latter suggestion and avers that it is becoming daily more clear that President Wilson's League of Nations is too "quixotic" to be realized at once, and adds:

"As a matter of fact, an alliance has been arranged between Great Britain, America, and France, and the idea that the League covenant makes all international agreements unnecessary is no longer tenable. The only question regarding the renewal of the Anglo-Japanese Alliance is as to how it should be modified."—*The Literary Digest,* July 17, 1920.

UNITED STATES

NAVY DEPARTMENT—BUREAU OF CONSTRUCTION AND REPAIR

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—DEGREE OF COMPLETION, AS REPORTED JULY 31, 1920

Type, number and name	Contractor	Per cent of completion			
		Aug. 1, 1920		July 1, 1920	
		Total	On ship	Total	On ship
Battleships					
44 California	Mare Island Navy Yard	92.9	90.9	92.4	90.1
45 Colorado	New York S. B. Cpn.	55.1	46.3	51.1	40.8
46 Maryland	Newport News S. B. & D. D. Co.	77.7	25.9	76.	74.
47 Washington	New York S. B. Cpn.	48.9	37.8	47.8	35.8
48 West Virginia	Newport News S. B. & D. D. Co.	31.5	15.5	30.5	13.5
49 South Dakota	New York Navy Yard	13.3	5.5	12.5	5.
50 Indiana	New York Navy Yard	10.9	3.1	10.1	2.6
51 Montana	Mare Island Navy Yard	11.	3.4	10.9	2.9
52 North Carolina	Norfolk Navy Yard	14.1	7.9	12.5	6.5
53 Iowa	Newport News S. B. & D. D. Co.	4.5	3.5	4.5	2.
54 Massachusetts	Beth. S. B. Cpn. (Fore River)	....	....	....	......
Battle Cruisers					
1 Lexington	Beth. S. B. Cpn. (Fore River)	.7	....	.6	......
2 Constellation	Newport News S. B. & D. D. Co.	.7	....	.6	......
3 Saratoga	New York S. B. Cpn.	.7	.2	.7	.2
4 Ranger	Newport News S. B. & D. D. Co.	.7	....	.6	......
5 Constitution	Phila. Navy Yard	1.	.3	1.	.3
6 United States	Phila. Navy Yard	1.	.3	1.	.3
Scout Cruisers					
4	Todd D. D. & Const. Cpn.	58.5	4[illegible].2	54.7	40.5
5	Todd D. D. & Const. Cpn.	51.3	36.5	49.9	30.5
6	Todd D. D. & Const. Cpn.	34.4	10.7	29.7	6.4
7	Beth. S. B. Cpn. (Fore River)	8.7	4.6	6.	2.9
8	Beth. S. B. Cpn. (Fore River)	8.7	4.6	6.	2.9
9	Wm. Cramp & Sons Co.	48.	....	45	......
10	Wm. Cramp & Sons Co.	47.	....	43.	......
11	Wm. Cramp & Sons Co.	20.	....	19.	......
12	Wm. Cramp & Sons Co.	20.	....	19.	......
13	Wm. Cramp & Sons Co.	20.	....	19.	......
Miscellaneous					
Fuel Ship No. 17, Neches	Boston Navy Yard	88.9	87.8	84.	83.
Fuel Ship No. 18, Pecos	Boston Navy Yard	32.3	24.5	31.5	20.
Gunboat No. 21, Asheville	Charleston Navy Yard	Com.	7/6/20	99.8	99.8
Gunboat No. 22	Charleston Navy Yard	54.1	41.1	48.2	36.2
Hospital Ship No. 1, Relief	Phila. Navy Yard	94.	92.5	89.5	87.5
Amm. Ship No. 1, Pyro	Puget Sound Navy Yard	99.9	99.9	99.9	99.9
Amm. Ship No. 2, Nitro	Puget Sound Navy Yard	98.5	95.5	98.	94.
Rep. Ship No. 1, Medusa	Puget Sound Navy Yard	53.	43.	50.8	38.
Destroyer Tender No. 3, Dobbin	Phila. Navy Yard	27.2	26.	24.7	23.
Dest. Tender No. 4, Whitney	Boston Navy Yard	.5	.5	......	......
Sub. Tender No. 3, Holland	Puget Sound Navy Yard	5.	....	4.2	......

In addition to the above there were 66 destroyers, 49 submarines, two tankers and four sea-going tugs under various stages of construction.

There were completed and delivered to the Navy Department during July, four destroyers, one submarine and one oil tanker.

Authorized but not under construction or contract 12 destroyers, seven submarines and one transport.

CIVILIANS AS NAVAL CHIEFS.—The American Press is already speculating on the changes in the Washington Cabinet that will take place as a result of the Presidential elections next November. As Mr. Wilson is not himself "running" for a third term, it is considered certain that all the most important posts in the government will be filled by new men, irrespective of whether the Democrats or the Republicans are successful at the polls. Among the Cabinet officials whose term of service is probably drawing to a close, Mr. Josephus Daniels is one of the best known. Since March, 1913, he has been Secretary of the Navy, and, whatever his critics may say, nothing can alter the fact that during the past seven years the United States Navy has undergone a phenomenal increase in size and power. At the present time it is much stronger, relatively and absolutely, than at any period of its history, not excepting the late 'sixties, when intensive shipbuilding during the Civil War had resulted in the creation of a huge but ephemeral fleet. The world-war was, of course, mainly responsible for the "national preparedness" movement which swept the states four or five years ago and culminated in the great three-year naval program passed in August, 1916. But it was due in no small measure to the zeal and shrewdness of Mr. Daniels that public support was gained for such an unprecedented bid for sea power. From a reputed pacificist and "Little Navyite" he became a most vigorous champion of sea armaments, so much so that until quite recently he was urging his compatriots to go on building battleships until they had made British supremacy a thing of the past. His latest program, it is true, did not find acceptance, but he has the satisfaction of knowing that the vessels authorized during his period of office will, when completed, make the United States battle fleet the strongest in the world.

But in spite of his undoubted service to the cause, Mr. Daniels has apparently failed to gain popularity in American naval circles, and the explanation is given by *The Scientific American* in the course of a recent article. However ignorant of technical matters a civilian Secretary of the navy may be at the date of his appointment, it would, our contemporary thinks, be impossible for him to discharge the duties of his office without gaining, as time goes by, a working knowledge of the complicated naval organization; and Mr. Daniels is no exception to the rule. But technical knowledge is not everything. Where the present Secretary is accused of having failed is in his inadequate appreciation of the high code of ethics which is instilled into young American naval officers at Annapolis, and fostered by service afloat or in the various duties and associations entailed in shore duty. "We are free to confess," says *The Scientific American*, "that the whole attitude of the Secretary during the recent Congressional investigation, in which so large a part of his effort was directed to personal attack upon what he conceived to be the idiosyncrasies of two of the most distinguished Admirals in the United States Navy, seems to show that he is as far from understanding the high character, lofty professional aspirations, and unselfish devotion of the officers of our navy to the service as he was when he first took up the office."

It is not for outsiders to comment upon this judgment in so far as it relates to a prominent American official, but our contemporary revives the old dispute as to whether the head of the navy should be a civilian or a naval officer, and that is a subject which has often been debated on this side, where the conditions, superficially different, are fundamentally the same. We are not surprised to find the journal in question taking the view that however desirable it might be, on technical grounds, to have a naval officer as Secretary—or First Lord, as the case may be—there are other and weightier reasons which make it necessary for the naval head to be a civilian. The same reasons apply with equal weight in this country, where it is now very rare to find any responsible critic who thinks the First Lord should be a naval officer. We quite agree, however, that more discrimination than is customary—either in Washington or London—

should be exercised in selecting civilians for this office. *The Scientific American* postulates as an essential qualification "a more than average knowledge of naval affairs, and preferably he (the candidate) should be a man who has acquired this knowledge as the result of a natural inborn interest in the subject." A case in point was that of the late Col. Roosevelt, whose enthusiasm for naval affairs antedates his appointment as Secretary of the Navy and made his administration exceptionally intelligent and purposeful. We must, however, admit that very few of our own First Lords have possessed this qualification. Here, as in America, the head of the navy is appointed more on the grounds of faithful political service to his party than for any technical knowledge that he may possess. But there is this important difference between the two systems, that whereas the First Lord rarely meddles with technical matters, and if he did would find himself resisted by the Sea Lords, whose resignation in a body could not fail to shake his own position, in America the Naval Secretary is virtually an autocrat, vested with supreme power over every branch of the navy and able to impose his own ideas on the service, however repugnant or contrary to practice and tradition they may be. We do not think there can be any question as to which of the two systems is the best or most consistent with the ideal of democratic government.—*The Naval and Military Record,* July 14, 1920.

AN ESTIMATE OF THE SITUATION.—Every time we construct a battleship, or give their well-deserved military rank to the corps of nurses; every time we increase the number of chaplains or the ammunition reserve for machine guns; every time we add to the number of hours devoted to vocational training; every time we require more carbon copies for the procurement of supplies, and every time we raise the limit of the number of men a captain should command—if he can get them—we make a military decision. And yet a military decision is worth nothing unless it is based upon an accurate estimate of the situation.

What I suggest may have been already done; but it does seem to me that our problems of planning would be enormously simplified, the efficiency of our military and naval establishments greatly increased, and their cost materially diminished, if every decision concerning them was based upon a considered estimate of the situation.

It does not seem to me that it would be a difficult paper to prepare by the planning groups of the army and navy acting in conjunction. It is true that the State Department would have to be consulted, and it is also true that the broad lines of such an estimate should be a matter of consideration by the Cabinet; but until this is done, there seems no insuperable objection to having it prepared by the appropriate bodies of the Army and Navy and having it signed by the Chief of Staff of the army and the Chief of the Bureau of Operations of the navy. In this form it would serve as a guide for all military decisions and recommendations by both. It would express the considered military judgment of the army and navy and yet could be overruled and departed from by higher authority.

As I see it, this paper would run about as follows:

Estimate of the Military Situation for the Two Years Beginning January 1, 1921.

"*Purpose:* To defend the United States and its possessions.

"*A.* Mandatories.

"*B.* Countries with which during the next two years we shall probably have such relations as may eventuate in war.

"*C.* Countries with which during the next two years we may have such relations as might eventuate in war.

"*D.* Countries with which during the next two years it is improbable that we shall have such relations as could eventuate in war.

"*A1.* Force required to execute our duty under mandates, given separately for each mandate. In this connection it may be noted that Cuba,

Haiti and San Domingo are essentially mandatories, although not under the League of Nations.

"*B2.* Force at the disposal of each of the countries under the *B* list.

"*B3.* Force required by us to hold in check and destroy such enemy force or combination of enemy forces which seem possible during the two-year period."

A copy of this paper would be sent by the Secretaries of War and of the Navy to each member of the Military and Naval Affairs Committees and of the Foreign Relations Committees of the Senate and House of Representatives.

Manifestly it would be a confidential document, but obviously it would not be highly inexpedient if its contents were divulged unofficially. It is not considered inexpedient for a city to be known to have a dependable police force, and I, for one, believe that, if Germany had known that Great Britain stood ready to intervene with her full power if the neutrality of Belgium were violated, there would probably have been no war of 1914.

It is quite true that the men who draw up such a paper can make no claim to omniscience, but they could certainly employ the same degree of foresight which is exhibited in the conduct of large business affairs, and planning for war has many of the requirements which control planning for a great engineering work. In our international relations we can certainly see fairly well two years ahead. It may be said that in 1913 it would have been inconceivable that in 1915 there would have been men in the United States who contemplated the possibility of sending American forces to France, and that accordingly such an estimate drawn up in 1913 would inevitably have been grossly in error. But would such an estimate, if drawn up in 1913, have been really in error? It is inconceivable that circumstances would have arisen requiring us to send an army to Enrope except to operate in conjunction with the armies of other countries for whom Germany would have been on the "B" list, so to speak, and whose military information concerning Germany would accordingly have been available to us the moment our relations grew strained.

The value of such an estimate as the basis of study and planning, if drawn up in 1915, is obvious.

Such a statement as I have suggested should manifestly be succint. For example, there is no room in it for details of army organization, and, furthermore, such details are not necessary. It would be possible to adopt units of comparison which would be sufficient for that purpose and which could be supplemented by further information if it were required. Such units could be gun power afloat and available during the two years covered, and the number of rifles which could be put into action. Gun power afloat carries with it auxiliary services, and so do rifles. If it were desired to go deeper into the matter, it would be perfectly possible to do so.

Such an official statement would give something definite to work upon. It would confine investigation, study and preparation to the assigned limits, and it would eliminate side shows which are always expensive and which, save in the minds of their proponents, have little military value. The purpose of an army and a navy is to fight. Everything else is subordinate to that and, being subordinate, can probably be dropped to advantage. After all, the United States as a going concern can only spend a certain amount of money for insurance. It has a right to know that this money is really being spent for insurance and that it assures.

Such a statement would introduce into military planning the question: "Why?" That question is a most important one in efficient administration. It requires that proposed expenditures should be for objects embraced in the considered scheme, and an estimate of the situation gives a means of ascertaining whether they do in fact have a place in that scheme.

Such a statement would be of great value in the hearings before congressional committees which are a part of our system of government. As it is now, they are apt to be conversations about a table, desultory, indefinite,

and long drawn out. With such an estimate before them, members of committees would be in the position of a board of directors questioning technical men upon a project. The army and navy witnesses would be in the position of agents selling protection, and they could be required to explain in detail just why and how any of their proposals meant protection. I do not see that the present method of committee hearings gives this information. It is true that there are many witnesses, but the testimony does not interlock and it is not correlated. With such a statement before them the members of the committee having hearings could ask "Why?" intelligently and judge whether the explanation was sufficient to warrant the expenditure.

Military establishments, like other governmental agencies, grow like trees, putting forth shoots and limbs. It is a sign of vigor that this should be so. Dead trees do not grow. But each governmental tree has its place in the park and cannot be allowed to crowd out its neighbors. Under our present system the trees interfere with each other, try to overshadow each other; each considers that it alone is entitled to soil and light and air. This means a gardener with a pruning knife and a plan of the garden. To-day we let the trees crowd each other until finally the gardener has to use an axe.

Although we are a warlike people we are not a military one. War has never been a primary industry of the United States. We wage war as a tremendous stunt. We like to improvise our military machine, use it with full vigor, then scrap it and turn to something else. Yet the only way to obtain rapid, efficient, and economical construction is slow and accurate preliminary planning. I think that such an estimate of the situation would be of material assistance in such planning.—*The Infantry Journal.*

MERCHANT MARINE

GOVERNMENT AND PRIVATE SHIPBUILDING DWINDLING.—Shipbuilding for both government and private account is now on a declining scale, says a statement just issued by the Atlantic Coast Shipbuilders' Association. Shipping Board construction has been dwindling from month to month for some time past, but June marked the first decrease in the amount of private tonnage under way. Practically no new orders are in sight and the prospects are that the great bulk of the work in hand will be completed by the end of the year.

Since the first of January the shrinkage in the work on hand in American yards has been nearly half a million gross tons. While private orders show an increase in this period of about 475,000 gross tons, this is offset by a loss of more than double that amount in the total of government construction under way. An analysis prepared by the Atlantic Coast Shipbuilders' Association from the records of the Shipping Board, the Department of Commerce, the American Bureau of Shipping and Lloyd's Register of Shipping shows that a year ago the Shipping Board alone had over a million gross tons more building than the board and private interests combined have to-day.

Private orders in hand in May showed an increase of 61,926 gross tons over the amount for the previous month, but the June total showed a decrease of 12,522 tons from the May figure. During June the Shipping Board laid only three new keels, representing 18,666 gross tons, as against deliveries for the month of 31 vessels aggregating 143,772 tons, reducing the total construction under way for the account of the government by 125,000 tons. As a result, building for private account is now 438,000 tons in excess of that for the Shipping Board, whereas at the first of the year government construction was nearly a million tons more than the total of private orders.

The high water mark for American shipyards was reached in March, 1919, when 3,733,000 gross tons were being built, in comparison with

2,469,000 tons at the present time. The latter figure compares with a total production of 4,318,000 gross tons last year, on which basis of output the work now in hand is sufficient to keep the yards employed only slightly more than six months. British shipyards at the beginning of April had 3,394,000 gross tons under way, almost a million tons more than the present total in this country.

Records covering the last nine months, prepared by the Association shows the fluctuations in volume of tonnage since the yards began to receive orders for private account on an appreciable scale. These show that the decline in government orders has been unbroken during this time and that the increases in private orders, after slowing down, have now become losses. The following table gives the construction under way, in gross tons, for both accounts:

1919	Shipping Board	Private orders	Govt. tonnage lead
October	2,600,146	347,343	2,252,803
November	2,300,380	550,714	1,749,666
December	2,095,308	805,147	1,290,161
1920			
January	1,975,000	977,488	997,512
February	1,829,284	1,256,573	572,711
March	1,629,288	1,337,445	291,783

1920	Shipping Board	Private orders	Private tonnage lead
April	1,311,623	1,404,198	92,575
May	1,140,683	1,466,624	325,941
June	1,015,577	1,454,102	438,525

The total tanker tonnage under construction increased slightly during June, but freights and other types of vessels under way decreased. Increases continue to be shown in the completions of ships in hand and further gains in this direction will add materially to the lessening of the volume of work, as new orders are not sufficient to bridge the gap. How the various kinds of vessels building for private account have varied in the period under review is shown as follows, in gross tons:

1919	Tankers	Freighters	Other types
October	74,437	235,523	37,383
November	214,940	295,493	40,281
December	369,084	400,556	35,507
1920			
January	476,742	470,197	30,549
February	588,565	620,567	47,441
March	722,549	561,455	53,441
April	745,140	623,917	35,641
May	807,325	619,890	39,409
June	812,325	602,853	38,924

It will be some time before the effect of the Merchant Marine Act of 1920 is felt, and in the meantime it seems apparent that shipbuilding activities are to be very considerably curtailed.—*The Nautical Gazette*, Aug. 7, 1920.

GROWTH OF AMERICAN SHIPPING.—On June 30, 1920, the close of the fiscal year, the shipping registered, enrolled, or licensed under the American flag, according to the official returns of the Bureau of Navigation, Department of Commerce, comprised 28,150 vessels of 16,350,000 gross tons. Final returns of smaller vessels built, lost, or abandoned will change

slightly these figures one way or the other, but probably not to the extent of 100 vessels and 12,000 gross tons. Since January 1, 1919, closely following the armistice of November 11, 1918, American shipping in round numbers has increased 5,000,000 gross tons, and during the fiscal year just ended the increase has been 3,400,000 gross tons, of which 3,100,000 gross tons are documented in the name of the government of the United States, represented by the Shipping Board. The table below shows the main features in the growth of American shipping since January 1, 1918.

The seagoing ships of 1000 gross tons or over by which our foreign trade and the more important branches of our coasting trade are conducted are separately stated. The striking feature is the growth of government ownership through the Shipping Board, based on the large appropriations by Congress for shipbuilding and operation to win the war. Such appropriations ceased with the fiscal year just ended, and further additions to the government's fleet will require sales from the present government fleet to private owners, so that the tonnage under government

Date	Seagoing of 1,000 gross tons and over				Seagoing and non-seagoing of 5 net tons and over, Shipping Board and private ownership.	
	Shipping Board vessels		Private ownership			
	Number	Gross tons	Number	Gross tons	Number	Gross tons
Jan. 1, 1918....	105	413,631	1,036	3,268,069	26,742	9,343,224
Jan. 1, 1919....	608	2,305,015	1,055	3,351,841	27,217	11,261,444
July 1, 1919....	982	3,827,203	1,076	3,472,819	27,513	12,907,300
Aug. 1, 1919...	1,083	4,251,788	1,068	3,453,603	......	....
Sept. 1, 1919...	1,170	4,621,502	1,075	3,478,506	......	....
Oct. 1, 1919....	1,255	4,984,583	1,079	3,502,512	28,045	14,173,337
Nov. 1, 1919...	1,355	5,397,369	1,076	3,494,494	......	....
Dec. 1, 1919...	1,420	5,686,906	1,101	3,571,064	......	....
Jan. 1, 1920....	1,465	5,940,742	1,119	3,648,018	28,338	15,239,288
Feb. 1, 1920...	1,505	6,129,924	1,136	3,704,170	......	....
Mar. 1, 1920...	1,516	6,248,851	1,153	3,742,682	......	....
Apr. 1, 1920 ...	1,539	6,402,647	1,166	3,790,585	28,058	15,720,744
May 1, 1920 ...	1,575	6,599,801	1,182	3,851,211	......	....
June 1, 1920...	1,610	6,801,536	1,191	3,879,489	......	....
July 1, 1920....	1,630	6,903,128	1,209	3,942,974	28,150	16,350,000

ownership is virtually at its maximum. The last two columns in the table give the quarterly returns for all documented shipping of the United States, including the seagoing ships in the first four columns.

American Documented Merchant Vessels.—The number and tonnage of American documented merchant vessels on specified dates are stated below:

The fleet of seagoing ships, each over 1000 gross tons, aggregating 2839 of 10,846,102 gross tons, consists of 2065 steel steamers of 9,270,418 gross tons and 377 wooden steamers of 933,424 gross tons (the small number of large motor ships being included with the steamers), and 99 steel sail vessels or schooner barges of 186,330 gross tons and 298 wooden sail vessels or schooner barges of 455,930 tons.

Seagoing vessels less than 1000 gross tons but over 500 gross tons not included in the table above number 565 of 432,639 gross tons. Including these smaller vessels, American tonnage on June 30, 1920, was distributed as to trade as follows: Registered for the foreign trade, 2541 ships of 9,531,190 gross tons; enrolled for the coasting trade by sea, 863 ships of 1,747,551 gross tons. The year's increase has been almost wholly in ships registered for foreign trade.—*The Nautical Gazette,* Aug. 7, 1920.

AMERICAN AND BRITISH SHIPBUILDING.—On another page will be found a summary of Lloyd's shipbuilding returns for the three months ending June 30. They show that as against an increase of 80,587 gross tons in the first quarter, the amount of new tonnage under construction in the world's shipyards (exclusive of those in Germany) declined 221,046 tons in the second quarter of this year. Eight countries report an increase in the amount of shipbuilding under way, while in eight others a decrease occurred. The total tonnage building on the first of this month was 7,720,904 tons. This is more than two and one-half times as much as was under way at the same date six years ago, when the corresponding figure was only 3,162,000 tons.

Our maximum shipbuilding effort was attained at the end of March, 1919, when the tonnage under construction in American and British yards footed up 4,185,523 and 2,254,845 tons respectively. We then led the United Kingdom by 1,930,678 tons. To-day the situation is completely reversed, Britain having 3,578,153 tons under construction as against 2,105,056 in this country. While there are only 366 steel steamers building in American as compared with 888 in British yards, those being turned out here average 5609 gross tons as against 4012 tons for the British vessels. We can therefore console ourselves with the fact that, although we are not building half as many steel craft as our British cousins, the average size of the vessels we are completing is one-third greater.

Up to this, Great Britain has shown a steady gain each quarter in the amount of tonnage under construction. The probabilities are, however, that new vessel construction in the United Kingdom has about attained its peak. The increase shown in the second quarter was only 183,728 tons as against one of 400,176 tons reported in the first quarter. As 72 contracts for new vessels to be built in British yards are said to have been cancelled in the single month of June, the chances would seem to favor a decline rather than a further increase in the amount of new tonnage under construction in the United Kingdom. It is a striking fact that, while the capacity of British yards has been enormously increased and many additional building berths laid out in them since 1914, their tonnage output has been about the same as in a normal period before the war. Thus new ships produced on the Clyde during the first half of this year aggregated 286,946 tons as against a corresponding output of 348,476 tons in the corresponding half of 1913. Shorter working hours and a lack of shipbuilding materials account for this disappointing showing. After all, it is not the tonnage under way, but the amount that is being sent into the water from month to month that counts. If the tonnage launched in the two countries during the last two quarters be taken as the true test, the showing of the United States will be found to be not nearly so far behind that of Britain as the figures of tonnage laid down would indicate.—*The Nautical Gazette,* July 31, 1920.

BENSON EXPLAINS SHIP PROBLEMS TO ADVERTISING MEN.—"I believe the problem is very largely yours," said Admiral Benson, chairman of the Shipping Board, on July 14, to a representative meeting of New York advertising men, when discussing the disposal of the Shipping Board's vessels.

Admiral Benson outlined the whole situation facing the Shipping Board. Figures bulked largely, although, like Mr. Lloyd George, he used them chiefly as adjectives to convey the immensity of the task before the country. He appealed to the advertising men to assist the Shipping Board in creating throughout the country a genuine interest in ships and shipping, and more specifically, in helping the board to dispose of the vast amount of tonnage still on its hands, not to speak of the large quantities of ship supplies still unsold.

It can be safely said that Admiral Benson made a very favorable impression by his natural manner and simple, sincere talk. He attemated no

tricks of oratory, but told a plain unvarnished tale. After 47 years of active service in the United States Navy he had, he said, earned his retirement and had only taken up his work with the Shipping Board as a patriotic duty. After his address he invited questions and many were asked. A strong defence was offered of the Hamburg-American and North German Lloyd deals.

Praises New Shipping Act.—The Admiral started out by praising warmly the new Merchant Marine Act. It was, he declared, one of the most constructive acts passed in many years by Congress. What was more, he added, it was passed almost unanimously. Some of its defects were due, not to the personal convictions of members, but to influences brought to bear on them from the outside.

It was a mistake, said the Admiral, to regard the Shipping Board as a necessary evil left over from the war and as something to be eliminated at the earliest possible moment. On the contrary, it was a permanent body created to last as long as the nation's shipping lasted. Its function was to render the same service to shipping as the Interstate Commerce Commission rendered to transportation on land. Personally, he thought the Shipping Board had performed a splendid service to the country. He had told Mr. Hurley that the way in which the latter had taken hold of the board's various enterprises marked him as a great man.

Among the interesting figures given by Admiral Benson and compiled up to June 30, 1920, were percentages of geographical allocation of Shipping Board tonnage, as follows: Northern Europe, 39 per cent; Southern Europe, 10 per cent; Transpacific, 16 per cent; South America, 11 per cent; Southern Europe, 10 per cent; West Indies and Caribbean, 9 per cent; Domestic 7 per cent; Africa, 3 per cent; between foreign ports, 3 per cent.

The distribution of Shipping Board vessels according to the ports they operate from was as follows: From North Atlantic ports, 615. Gulf ports, 184; in tramp service, 121; Pacific ports, 113; coastwise, 74; between foreign ports, 63; South Atlantic ports, 62. From New York there operate 273 Shipping Board steamers; from Norfolk, 133; from Baltimore, 101; from Philadelphia, 75; from Boston, 28, and from Portland, Me., 5.

"The war," said Admiral Benson, "has still left us one very strong competitor and one whose existence depends largely on the success of its merchant marine. But the percentage of our tonnage in relation to the necessities of our commerce is such that there should be no conflict of interest. We all know what it is that leads to trouble. It is selfishness and self-interest.

Deprecates International Irritation.—"In the attitude I take in pushing the merchant marine I want to shape things in such a way that there shall be no international irritation. All I wish to do is to defend our inalienable right as a great people. The new Merchant Marine Act contains only what is necessary for our national development and our commerce both foreign and domestic. But we should proceed with due regard to the necessities and feelings of our foreign competitors. We should enter into the thing in a spirit of friendly competition, with some feeling for the necessities of other nations. When all is said and done some of them are more dependent upon their commerce than we are, and we should give them due consideration. But under no circumstances should we allow anybody to dictate to us what our policy should be.

"The struggle is going to be keen and the fight severe, and we cannot succeed unless we have the united effort of the whole country. In my opinion we cannot succeed with ships owned and operated by the United States Government. Human nature is such that individual interest is necessary to success. A strong personal effort is needed. If you have the inexhaustible treasury of the United States behind you you will not work with the same effort and make the same sacrifice as if you were dependent on your own resources.

"I am not criticising those who are operating our ships, but it is a fact that somehow or another boats do stay longer in port than they should and more money is probably spent on repairs than would be the case if the ships were in private hands. For these reasons and for many others it is impossible in my opinion to have the United States properly and efficiently and indefinitely own and operate its merchant marine. To do so would, in my opinion, deaden business interest and initiative. As it is we are depending too much on other people doing the job for us.

"There is no intention to use Section 28, providing for discriminatory railroad rates, without due regard to our foreign competitors. It is not intended to apply the law brutally. Our idea is to make our competitors play the game fairly.

"So far, our sales policy has not been published, because we don't want to commit the incoming board, though I have no doubt it would be accepted if it were published. We will not sell any ship that is engaged in a successful trade route. It seems now as if South America and China were going to be our principal markets. I can say now that we do not intend to give the ships away at a ridiculous figure.

Hamburg-American Deal.—"Much has been said about the Hamburg-American proposition and the proposed arrangement with the North German Lloyd. We all have our opinion about the Hamburg-American Company before the war, but there is one thing beyond dispute: it was a successful business organization. The agreements which are being reached with the two German companies are strictly business propositons and not in any sense a love-feast.

"The situation was that if we had refused to enter into any agreement with the German companies our shipping would have suffered, because the Hamburg-American would have gone in with our competitors and would have obtained in that way the privileges they were seeking. In such a case we would have been in the position of having refused to co-operate and would have incurred a wide measure of hostility.

"In the case of the North German Lloyd it is simply a question of renting their docks and other terminal facilities. I am convinced that the companies making agreements with the Hamburg-American and the North German Lloyd are thoroughly American and that the propositions are good ones from an American standpoint. At least unless you can convince me that it is easier to climb over a fence than to go through a gate you cannot persuade me that the propositions are not good. If we had not negotiated them we should have been in an impossible position."

As to the Leviathan.—In answer to a question about the *Leviathan*, Admiral Benson said the situation with regard to the big German liner was a very trying one. It was difficult, he said, for any one firm to raise the necessary funds to buy the vessel and recondition her with the money market in its present state. Personally he felt much inclined to accept the offer made for the *Leviathan* by the United States Mail Steamship Company. This offer was $3,000,000 stipulated on a Shipping Board loan of $6,000,000 for reconditioning purposes. Application of 25 per cent of the net earnings of the vessel for ten years was also a condition of the offer.

A questioner asked Admiral Benson what would happen to American ship-building if two years from now the price of tonnage in British yards were about $100 a ton and in American yards around $150. "I believe, that, if anything, it will be the other way round," was the Admiral's reply.—*The Nautical Gazette*, July 24, 1920.

COUNTER-ATTACK ON JONES BILL ADVOCATED.—In the face of the Jones Bill, our obvious duty is likewise to put ourselves into the position of the strong man armed, says the "Look Out Man" of London *Fairplay*. America may never need to use her weapon in such a way as to injure us; it is a certainty that there would be still less chance of her doing so if we were able to retaliate in kind. To-day she proposes to extend her

coastwise trading restrictions to her insular dominions, and, in effect, to subsidize her railways for the benefit of her mercantile marine. Whether Sir Eric Geddes has any similar plan in his head regarding our overseas and coasting trades I do not know; but, so far as our coastwise traffic is concerned—I use coastwise in the fullest Imperial sense, and as embracing all the British dominions—it is essential that we should take such steps that, should the operation of the Jones Bill be such as to cause unfair injury to our shipowners and merchants, we should be in a position immediately to put up a polite but effective counter-offensive.

We possess all the materials for the manufacture of a big club, for not only could we make ourselves self-supporting within the Empire, but many of our old-time customers could not do without us, and, in addition, our dominions have mercantile marines of their own capable of carrying the fight into those markets which might be lost to us were distance a factor in the situation. The question is: What steps do our government propose to take in the way of anticipating, let us say, the remote possibility of the Jones Bill being strictly interpreted and enforced? If our traders find themselves met by notices warning them to beware of spring guns and man traps in districts where hitherto they have been free to carry on business, they will naturally expect that, for their protection and for that of the nation generally, similar action will be taken along our own coast-lines. But, if that ever has to be done, we must have the means of doing it, and the United Kingdom must not do it off her own bat. An Imperial Conference should be called, the dominions' views should be taken, and a joint policy should be drawn up and published, so that no competitor would have any cause to feel aggrieved if it were suddenly found that Great Britain, for once, was prepared to do unto other as they sometimes have been a little overready to do unto her.—*The Nautical Gazette,* July 31, 1920.

AERONAUTICS

HELIUM PRODUCTION BY THE GOVERNMENT.—Fort Worth Tex.—It is authoritatively stated that the government will proceed with its original plans for the construction here of a helium production plant to cost approximately $5,000,000. The experimental plants for obtaining helium from the natural gas of the Petrolla field have been in successful operation at Fort Worth and Petrolla for more than two years.

Several months ago a Congressional committee made an adverse report on the construction of the proposed plant here on the ground that the cost of extracting helium was too heavy to make it a feasible enterprise. This report seems to have been of no effect, as contracts have just been let for enlargements of the initial plant here. The Reagan Construction Company of Baltimore, Md., has been awarded the contract for a gas storage house to be built of sheet steel, a water settling basin and a water supply system. The natural gas pipe line from Petrolla to Fort Worth, which was constructed by the government is practically finished. The contract has just been awarded for the construction of concrete gig boxes for the pipe line. It is expected that the big plant here will be finished and placed in full operation about October 1. The helium gas will be for the use of the army and navy, Lieut. Commander R. G. Walling, U. S. N., has been detailed in charge of the plant.—*The Aerial Age Weekly.*

FIFTEEN TORPEDO PLANES FOR U. S. NAVY.—Contracts have been let with the Stout Engineering Laboratories, Detroit, Mich., for six torpedo planes for the U. S. Navy. The Curtiss Engineering Corporation has been awarded the contract for nine torpedo planes.—*Aerial Age Weekly,* Aug. 2, 1920.

RECORD FLIGHT OF NAVY SEA PLANES.—Report has been filed with the Office of Operations, Navy Department, of a record flight made by three

F-5-L Navy seaplanes on the Pacific coast. Flying from San Francisco to San Diego without stop the seaplanes made the distance in six hours and forty-five minutes. On the return trip to San Francisco one of the planes was forced to land on the water because of motor trouble and was delayed twenty minutes, and then continued without stop. The entire trip was so highly successful that it is believed the *F-5-L* type seaplane can be used for photographing the entire California coast.—*Aerial Age Weekly,* Aug. 2, 1920.

THE GERMAN ALL-METAL AEROPLANES.—The first all-steel cantilever monoplane was produced by Junkers in December, 1915, after many model tests in his wind-tunnel at Aachen; it was equipped with a 120 h.p. Mercedes engine.

"Successful trial flights were made at Doberitz in January, 1916. As a result, the German Army gave him orders for armored aeroplanes, but compelled him to design them as biplanes. Various other Junkers all-metal monoplanes are shown in the photographs.

"The L. F. G. Roland seaplane works at Stralsund built an aluminum scout monoplane designed to stow on board a submarine when dismantled. This machine was fitted with a 110 h.p. Oberwesel engine, had a net weight of half-a-ton, and could carry a useful load of 189 kg. The wing area was 13 sq. m. and the span 10 m. The climb was 1000 m. in 9 minutes and 2000 m. in 21 minutes.

"Another machine was designed too late for the war, but has been produced since as a passenger carrier. It is a flying-boat of the wireless monoplane type, with rigid bracing. The pilot's cockpit with the passenger cabin behind it, is built on the front part of the hull, and the cabin structure extends up to the wing. The engine is mounted above the wing on an inverted vee-cabane. The planes are cut away for the pusher propeller. The engine is a 120 h.p. Mercedes, which is to be replaced by a 185 B.M.W. The speed is 140 km. p.h.; 110 litres of petrol are carried for a 3 hours' flight; the range at cruising speed is 520 km. Net weight 635 kg., gross, 1125 kg. Main dimensions: Span, 13½ m.; length, 8.33 m.; height, 2.82 m.

"The Staaken Works of the Zeppelin Company are at present engaged on the E-4-250a, a giant aluminium monoplane with four 260 h.p. Maybach engines mounted as tractors on the leading edge of the wing. Mechanics are accommodated in a lying position inside the aerofoil, and can attend to the engines in the air. The speed expected is 190 km. p.h. full out and 170 km. at three-quarters power. The surface loading is very high. There is accommodation for 18 passengers or 1 ton of paying load, and the range will be 1000 km. The machine can maintain flight in the air with only two engines running."—*The Technical Review,* July 20, 1920.

NAVY PLANES FOR SPOTTING FISH.—A regular fish patrol operating from the naval air station at Hampton Roads, Va., has been inaugurated, and each morning at 5 o'clock a flying boat carrying pilot, radio operator and fish spotter leaves the station to aid fishing craft. The grounds from Assateague to Currituck are covered and it is stated that fish have been sighted each day and fishing vessels directed to the schools. In two instances the fishing vessels were directed to large schools of menhaden and made record catches.—*The Aerial Age, Weekly,* July 19, 1920.

ENGINEERING

MOTORSHIP.—. . . . While the motorship as a successful and economic vessel in competition with steamships, is a reality, and has, therefore, passed through the first natural stage of any great development, it finds itself at the beginning of the second two stages, which are: First, public recognition of its value and second, rapid and large scale adoption.

No further demonstration of reliability or economy of the motorship in those branches of marine service to which it is adapted need be made, be-

yond the collection, classification and analysis of facts gathered from existing motorships now in operation, unless perhaps there may be added as further proof the list of large firms that have invested great sums of money in building or in preparation for the building of these vessels and their machinery, on the basis of their own convictions, so to be ready to meet the production demand that must inevitably follow the complete publicity of the demonstrated facts.

The fundamental element of the motorship, the element that is responsible for all of its characteristic economic qualities, is the Diesel oil engine which is used both for propelling the vessel in large units directly, and in small units also for driving electric generators, the current from which operates all auxiliary machinery. This type of internal combustion engine is now completing a period of 25 years of development for all purposes and, therefore, as such cannot be regarded as a novelty. In point of fuel consumption and efficiency, it is the most economical type engine known. As built for ship propulsion, it is usually provided with six cylinders, somewhat like the six cylinder automobile, but on an enormously larger scale, developing up to 500 horsepower per cylinder at low propeller speeds as a present high limit. It is direct connected to the propeller shaft, just like marine steam engines, and also like them, is reversible and capable of quite the same sort of maneuvering with starts, stops and reverses, as proper ship handling may require, using for this, compressed air produced by the small auxiliary engine. Like the more common automobile engines, it has the usual cam operated inlet and exhaust valves, but differs in certain important results. Instead of being water jacketed only around the cylinders and heads, its pistons are also jacketed because they are so large. Instead of attaching connecting rods to the pistons directly, these rods are pinned to crossheads, working on guides, and which in turn are connected to the pistons, by piston rods, a difference also due to the heavier parts, and conforming exactly to marine steam engine practice. Instead of drawing air inward through carburetors, air alone is drawn directly from the engine room into the cylinder, and compressed to a pressure of over 400 pounds per square inch. This makes the air practically red hot, and into this air a heavy fuel oil is injected for the first eighth of the out-stroke, the oil burning steadily as it enters, without any explosion.

These changes make the main parts of the motorship engine quite similar to the same parts of the old standard marine steam engines, and by suitably proportioning these parts an equal reliability in operation is assured for these parts including bedplates, frames, thrust blocks, crankshafts, connecting rods, crossheads and piston rods. Those features of the oil engine that differ from the old marine steam engine are connected with the control of fuel supply and its combustion, and these include the valve gear, fuel oil injection pumps, spray valves and compressed air for spraying, besides the cooling of the combustion chamber which is merely a matter of water jackets. All of these things are now fully developed to a degree of reliability quite equal to the other arts of the engine adopted from marine steam practice, and they are far more permanent than the equivalent steam boiler with oil or coal fired furnaces of the steam ship. In fact these special elements of the oil engine give no more operating trouble in the motorship than the corresponding elements of first class automobile engines which include the carburetor, ignition and water jacket system, but they have a longer life because of more liberal and conservative design, and better care by skilled engineers.

The mode of compressing air and injecting fuel into it for combustion, peculiar to the Diesel engine, is responsible for a very low fuel consumption, compared to automobile engines on the one hand, and also as compared to steam machinery on the other. This fuel oil consumption is equivalent to nearly 35 per cent thermal efficiency for the Diesel engine, the actual weight of oil consumed depending somewhat on its quality.

While satisfactory cooling conditions have been produced and are in use for engines of 3000 i. h. p. in six cylinders, the problem is more difficult

in larger cylinders, and development work on larger powers will not be seriously undertaken until the very large field that present sizes can meet is well filled. In twin engine ships this includes everything requiring 6000 h. p. or less, and in this range falls practically all cargo vessels as well as the smaller and slower passenger ships, and most, if not all, of the non-fighting ships of the navy.

A total of 2700 shaft horsepower would give a cargo vessel of 10,000 dead weight tons, a speed of 11 knots. At this power and speed a motor ship would burn for all purposes at sea about 13 tons of oil per day, against 35 tons for an economical oil burning steamship. The corresponding figures in port are .4 ton and 4.5 ton per day, for the motorship and steamship respectively. Therefore, the steamer consumes more fuel oil than the motorship at all times, eleven times as much in port and 2.6 times as much at sea.

This fuel oil saving of the motorship over the corresponding steamship is beyond question, though the difference may vary in numerical value with type and condition of the machinery of the steamer. It represents a yearly difference in dollars in favor of the motorship, which is larger, the higher the price of oil per barrel, and the more days per year, the ship remains at sea. Therefore, high fuel oil prices makes motorships more profitable than low prices compared with steamers, and it should be noted that the trend of oil prices is definitely upward. Very long voyages also favor the motorship, and its low fuel consumption makes it possible to carry enough for 20,000 miles in the double bottom.

The real value of a cargo ship is, however, measured by the total cost of its operation in terms of cost of carrying freight and this total cost includes certain fixed charges and depreciation, and certain operating charges, such as engine-room crew wages, repairs and overhaul, engine-room supplies, and insurance, all in addition to the fuel oil. While these terms must all be evaluated for each case under consideration, to arrive at a definite conclusion in the relative cost of operating steam and motorships, it may be said that excepting one item, the total of the rest will be substantially the same for both ships, or somewhat in favor of the motorship. This exception is the interest and depreciation on the capital investment, which, taken at equal rates, is always against the motorship.

It is estimated that these two types of vessels would cost: motorship—$1,950,000; steamship—$1,800,000, a difference against the motorship of $150,000. Charging interest and depreciation at 10 per cent, this imposes a yearly fixed charge of $15,000 per year against the motorship, which is neutralized when 5000 bbls. more oil are burned by the steamer than by the motorship at $3.00 per bbl. and all fuel burned in excess of this means clear gain. The steamship burns at sea 22 tons or 150 bbls. more oil per day than the motorship, so that only 33 days at sea are needed to equalize difference between fuel consumption costs and investment charges with oil at $3.00 per bbl. It is estimated that with due allowance for stays in port, an 11 knot motorship would be 133 days at sea per year between New York and Liverpool. New York to Buenos Aires 172 days at sea per year; New York to South Africa 307 days at sea per year. These figures show clearly that it would be easy for a motorship to neutralize its excess of yearly investment charges over the steamship by its low fuel consumption requiring a little more than one trip to Liverpool, less than one to Buenos Aires, and about half a trip to South Africa, with oil at $3.00 per bbl. The time would be shorter at higher fuel prices and longer at lower prices for oil than $3.00 per bbl.

The fuel economy of the motorship makes it cheaper to operate than the steamship in spite of greater investment charges, provided it is kept at work enough days per year for any given prevailing fuel oil prices, the total yearly cost differences depending mainly, though not exclusively on these two items of sea miles per year and fuel prices.

The lower yearly cost of motorship operation, compared with the steamship, is not the whole story, because there are some differences in cargo carrying capacity, in addition to very great differences in engine room working conditions which latter are decidedly in favor of motorships.

While the machinery weights for the steamer estimated at 550 tons are less than for the motorships, estimated at 630 tons, a difference of 80 tons in favor of the steamer, it must be remembered that the fuel consumption of the steamer is 2.6 times that of the motorship and the fuel weight in bunkers and tanks will more than neutralize this for trips of any considerable length. As an example, for a trip of 13,000 miles at 11 knots, the steamer will require 2100 tons of fuel, of which 1100 tons only may be carried on the double bottom bunker, so that 1000 tons must be carried in tanks. On the other hand, the motorship with the same 1100 tons in the double bottom cannot only complete the 13,000 miles without any extra tankage, but has still a margin of 7000 miles reserve capacity. This difference in fuel weight means an equivalent difference in cargo tonnage, though of course with very short trips this difference becomes less.

The situation as to bulk cargo is also favorable to the motorship, because in addition to the space occupied by extra fuel oil tanks required by the steamer, the motorship machinery space is usually shorter than for steam boiler and engine room; one estimate of this makes the space 58 ft. and 44 ft. long for the steam and motorships, leaving a margin of 14 ft. equivalent to 13,000 cu. ft. or 325 tons in favor of the motorship.

Complete absence of boiler rooms on the motorships as well as elimination of steam pipes in engine room makes the whole machinery space cool and comfortable, a matter of very great importance, especially in the tropics, because under these conditions, the engine room force can work in comfort, and better care of the machinery is sure to follow as a natural result of human nature.

Motorship construction was first undertaken seriously by the Scandinavians under the conviction that the new type of machinery could be made properly reliable, and that the savings to be expected in operation over steamships, was so great as to justify considerable expenditures for the necessary experimental and development work.

One of the first ship owning firms to act on this conviction was the Royal Dutch Petroleum Company. This company ordered its first Diesel ship in 1910, and at the beginning of the war they had thirteen (13) motor driven tankers in operation, all powered with Werkspoor engines. Their first vessel, the *Vulcanus* was the first ocean-going full-powered motorship ever built. Up to May, 1919, this vessel had covered 252,000 nautical miles and was still in satisfactory operation, notwithstanding the fact that her pioneer machinery is comparatively crude, judging by to-day's standard.

The Burnmeister and Wain Company, of Copenhagen, Denmark, has built to date 54 full-powered motorships with a total tonnage of 415,000, and a total power of 150,180 i. h. p. All of these vessels are now in operation.

The East Asiatic Co., of Copenhagen, Denmark, the pioneer company in the operation of large Diesel ocean going liners, once owned and operated 72,780 tons of steamships, but they have abandoned the use of these steam driven vessels in their oversea trade and are using motorships exclusively for this purpose. Mr. H. N. Anderson, managing director, cites as an example of the efficiency and reliability of this type of vessel the performance of the *Siam*, one of their 10,000 ton vessels, completed in 1913. The *Siam* sailed from Copenhagen to Japan and back on its first voyage, then across the Atlantic around Cape Horn to San Francisco, during which second voyage the motors ran 42 days and nights without stopping. From San Francisco she returned via Vladivostok and Suez to Copenhagen. The *Siam* is therefore the first motorship to circumnavigate the globe. In doing this she covered a total distance of 62,600 miles. This vessel has been in continuous operation since that time and is still in operation and performing very satisfactorily.

From the fact that the East Asiatic Company possesses a fleet of 15 motorships totalling about 120,000 tons, and had contracted for a further 250,000 tons up to 14,000 tons each, it is evident that the company has the greatest confidence in the motorship, and this is especially significant because of their original ownership of steamships.

The Rederiaktiebolaget Transatlantic Co. of Göteborg, Sweden, who own and operate the fine motorships *Bullaren* and *Tisnaren* are so pleased with their performance that they have prepared plans for converting their best steamship, the *Bolmen*, to Diesel motor power, at a cost exceeding the original investment. They have also contracted for five additional 12½ knot motorships of 9400 tons and one of 7500 tons, all to be completed before 1924.

The Grangesberg Co., of Stockholm, Sweden, has in operation or building 22 motorships aggregating 176,000 tons, and 57,200 i. h. p. (Trafikatiebolaget-Grangesberg-Oxelosund).

The Glen Line, Ltd. (Lord Pirrie's Co.), has eight ships afloat of 10,000 tons or over, with powers from 3100 i. h. p. to 6500 i. h. p. This company has a number of additional motorships on order including some of 13,000 tons, and 14 knots loaded sea speed.

There are now on order with shipbuilders in Holland for Norwegian owners, 14 ships of a total tonnage 75,500, and 35,350 i. h. p.

There are now being built in Italy 27 merchant motorships which will be fitted with engines, ranging from 300 to 2200 b. h. p.

Every shipbuilding nation in Europe is now building motorships. In many cases there are more motorships under construction than steamships and some yards build motorships exclusively. The motorship is most appreciated by its owners and most of the new construction is on repeat orders, though recruits are recorded regularly both among ship owners and operators ordering new motorships in place of steamships, and among ships and engine builders announcing their readiness to take and execute orders.

Thus, in but little more than ten years the motorship has emerged from the stage of hope and promise to that of commercial reality, and a new phase of the industrial revolution of the internal combustion engine has become a fact. The supremacy of steam at sea has passed never to return so long as a supply of liquid fuel is available.

The whole of this motorship development has taken place in Europe, and America has done nothing; nothing but continue to build steamships to compete with the more economical European motorships. America, the land of oil, and world leader in the production of motor cars, is only now beginning to realize that the motorship has arrived. While the American public is as yet but ill informed as to these facts, those interests most concerned, have accepted them and are acting on the conviction that motorship construction must now be undertaken by us, and that once seriously started, motor car history will be repeated by transferring the center of activity from Europe to America.

Large investments are now being made here in preparation for the handling of the large volume of business sure to follow public familiarity with the facts. In most cases these American firms are provided with European drawings and data and will reproduce European practice in their construction of motorship machinery, but one of these firms, Worthington, has taken the step of producing main and auxiliary machinery of its own design. The American Bureau of Shipping accepts the motorship as an insurance risk on the same basis as the steamship, and has issued similar rules for controlling safe constructions in the interest of owners and insurers. The United States Board of Steamboat Inspectors charged by law with the duty of establishing standard of competence of engineers in charge of the machinery at sea, and the issue of licenses to qualified persons, is fully alive to the situation and having accepted the motorship as a reality, is making plans to assure owners that their engineers are safe men. Schools

for training candidates for motorship engineers' licenses are being established and the better living conditions are attracting old steamship engineers to the new service. For proper publicity of motorship information all marine journals are giving increasing space to the new subject, but one journal "Motorship" devotes itself exclusively to this subject.

It would therefore seem as if the motorship was about to enter the last of the three stages of all development, following demonstration of reliability and economic value and acceptance of the facts by the special interests concerned, and that complete publicity of the situation must inaugurate a program of really large scale production and general use.—Dr. Chas. E. Lucke, *The National Marine*, June, 1920.

ALTERNATING CURRENT COMMUTATING MOTORS.—The early stages in the development of the alternating current commutator motor were hampered by difficulties in obtaining sparkless operation.

The problem of commutation was not sufficiently understood, and it was usual to consider it as fundamentally different from that of direct current commutation. It is now perceived that commutation in each class of motor is of the same nature, and that the difference is largely a matter of the values of the electromotive force short-circuited by the brushes. In the alternating current motor, as in the direct current motor, the short-circuited electromotive force is due to fluxes due to the amature magneto-motive force, but, in addition to these, there are introduced additional fluxes that are superposed on the ones just referred to, and complicate the problem.

The major part of the present article is concerned with a consideration of the different elctromotive forces that should be taken into account with various types of alternating current motors, and it is shown that the electromotive forces involved in speed control also have an influence on the commutation problem.

The paper concludes with a treatment of the general conditions of brush operation and commutation, and a comparison of the commutation limits for alternating current and direct current motors as given in the following table of limiting short-circuited electromotive forces for three types of loading:

(a) Load permitting continuous operation without undue deterioration of the commutator and brushes.

(b) One-hour loads followed by a period of lighter operation.

(c) Momentary or very short period load which would be quite destructive if continued for any considerable length of time.

Type of apparatus	Effective e. m. f. Shortcircuited		
	Load (a)	Load (b)	Load (c)
D-C. non-commutating pole traction motor (average of 9 sizes).	5 to 7	9 to 11	14 to 17
D-C. engine type Generators (non-commutating pole).	5 to 6	7 to 10	....
Special d-c. 3rd-brush motor—200 h. p.......	5 to 6	....	....
A-C. traction motors—doubly-fed and commutating pole types.	5 to 6	....	12 to 14
A-C. traction motors—resistance lead, non-commutating pole types.	7.5 to 9	9 to 11.5	13 to 15
A-C. industrial motors.....................	5 to 6.5	....	....
Frequency changers......................	5 to 6.5	8 to 10	....

(B. G. Lamme, *American Institute of Electrical Engineers, Journal*, Mar., 1920. 36 cols., 22 figs.).—*The Technical Review*, July 20, 1920.

SUBMARINE DETECTION IN AN ALTERNATING MAGNETIC FIELD.—The experiments described relate to the detection of submarines by their distorting effect on an alternating magnetic field set up by apparatus carried on a searching vessel.

"An alternating magnetic field is set up by a straight bar magnet with an open magnetic circuit. In the field of this magnet, and as far away as is practicable, is located a detecting coil with its plane parallel to the lines of force (in which case the magnet induces no voltage in the coil), or not parallel to the lines of force (in which case the induced voltage must be balanced out by a compensating field). In either case, the approach of a submarine will distort the alternating field, so as to cause a voltage to be induced in the search coil, which is detected by a suitable instrument. The signal will vary roughly inversely as the sixth power of the distance to the submarine, and so very sensitive detectors are required. This quality is possessed by three-electrode amplifiers.

"The first tests were made on model submarines 10 ft. long and 1 ft. in diameter, mounted on trucks, and the main difficulties consisted in balancing out the induced voltage in the search coil in phase and magnitude, the difficulty increasing as the amplification of the detecting apparatus was increased. Without amplification the detection was certain at 10 ft. distance, and this was increased to 50 ft. by using three stages of amplification.

"Further tests were made on full size steel hulls, and detection was found to be possible at 450 ft. distance with apparatus mounted on a pier head. With the apparatus mounted in a wooden submarine chaser 110 ft. long the limitations of power available and space for setting up the apparatus reduced the distance of detection to 200 ft. in smooth water.

"The generator had a capacity of 3½ k.w., and precautions had to be taken to eliminate the distortion of field produced by the steel bulk-heads. The alternating current magnet was 9 ft. long and had a cross section of 7.7 sq. in., and was placed just abaft the pilot house. The detecting and balancing coils were situated in the forward hold and in the wireless room respectively. All the wiring was enclosed in steel tubing in order to screen it. The motion of the boat introduced such disturbance in the magnetic balance that the sensitivity of the detecting apparatus had to be reduced to from one-half to one-tenth of the value used in the shore tests. (J. B. Whitehead and L. O. Grondahl, *American Institute of Electrical Engineers, Journal*, Mar., 1920. 22 cols., 5 figs. *The Technical Review*, July 6, 1920.

RADIO

RADIO WARNS MAIL PLANE.—Washington.—A practical demonstration of the value of wireless communication with commercial aeroplanes during flights was recently made in the operation of the regular mail plane between Cleveland and Chicago.

This aeroplane, a large Martin twin motor machine, left Cleveland under perfect weather conditions about 3 o'clock in the afternoon with the mail for Chicago. The wireless operator was in touch with various stations within a range of 100 miles. In the course of the flight the Cleveland station picked up the plane by wireless and transmitted a storm warning from the lower lakes for the aerial mail pilot. The radio operator at once got in touch with navy stations for further details as to the velocity and direction of the wind in the approaching storm, with the result that the plane landed at the emergency aerial mail station at Bryan, Ohio, where additional gas and oil were taken to meet the approaching head winds. The plane, being so reserviced, proceeded to Chicago and within an hour ran into a thunderstorm.

The radio operator reported that the lightning discharges were so near the plane that the amplifier of the radio set was paralyzed and that he was obliged to remove the radio helmet from his head. The antennæ absorbed

an electric charge while passing through clouds, shocking the operator. He pulled in the antennæ, until the storm had passed.

By this time darkness had set in and the pilot and the plane had an S. O. S. call sent to the stations surrounding Chicago, asking the field manager to set flares and turn on the flood lights to allow a landing in the dark. Seven amateur and regular radio stations responded, with the result that with this assistance the field was lighted.

It is the opinion of the post office authorities that this single instance in the use of radio in the mail work saved costly damage to a $40,000 aeroplane and possible injury to men which would have resulted from a crash in the dark.—*The Aerial Age Weekly*, July 12, 1920.

MISCELLANEOUS

THE NEW INSTRUCTION ORDER AND PERSONAL INITIATIVE.—By the time this Journal appears, all officers in the coast defenses and regiments will have received copies of the new Instruction Order, entitled, "Instruction of Coast Artillery Troops," which supercedes Special Regulations No. 22. It it believed the thoughtful officer will be impressed with what this order does not contain, as well as with what it does contain. The change in extent to which the details of instruction, target practice, inspections, and every other form of activity, are described from the manner of handling all of these subjects in every instruction order we have before known, is significant of the trend of the times in our army. The gist of the idea which can be read from this whole order may be drawn from paragraph 11.

"11. It is expected that Coast Artillery district and brigade commanders will exercise fully their initiative in and responsibility for the methods of instruction and target practice. However, it is desired to point out that the value of firing problems depends upon the nearness of their approach to service conditions and upon the training in gunnery which they afford. All service conditions need not be assumed to exist simultaneously; that is, the practice may have for its object the solution of the battery, battalion, fire, or fort command problem during some one particular phase to be anticipated under service conditions. From time to time the Chief of Coast Artillery, in training memoranda, will publish to the Coast Artillery suggestions as to firing problems, methods of conducting fire, and extracts from target practice reports."

The purpose is obvious, to develop initiative and increase individual responsibility. Every officer, from brigade and district commanders down, is presumed, under this Instruction Order, to be seeking the most effective results and to be conscientious in his own effort. It is up to us to demonstrate that this confidence is justified.

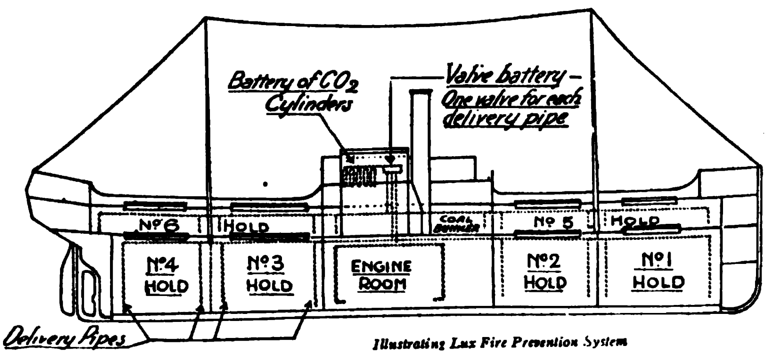
We miss the Figure of Merit, but we shall not regret its departure. The end now to be attained is, frankly, the development of methods which will promise effective sustained fire. With the elimination of the Figure of Merit from our concern, we are no longer compelled to smother our convictions in details of training and fire control, for the sake of trying to obtain the specious advantage of a Figure of Merit, which, however many factors and symbols it might contain, could never give a true measure of the efficiency of a battery or a battery commander, especially with as limited an ammunition allowance as will always prevail for our large caliber guns.

Personally we are delighted to see the emphasis placed upon Analysis and Analysis Boards. If analysis of practice has some times in the past been our bugbear, perhaps it has so been because of our failure to grasp the advantages of a proper use of analysis and because of a lack of prevision in preparing for it. All of us should prepare for analysis at practice by instituting analysis at drill. All of the data necessary for complete analysis of firing can be kept without confusion or worry on the part of any of the personnel assigned to a battery, provided the process is not interjected into the strenuous period of firing itself as a new and extraneous burden

imposed upon officers and men. The keeping of the data for analysis should be recognized as a part of a routine drill as much as receiving the meteorological message or transmitting data to the guns. The value of such a policy lies not only in the resulting freedom from confusion at the time of firing, but as well it enables the battery commander to analyze the work of each important member of his fire control section, so that day by day he can determine what mistakes each man makes and how many, and how to help them to eliminate the errors which, if undetected at drill, will be incorporated in the results of firing.

When we come to shoot, we will be able to appreciate to what a marked extent the latitude permitted by this latest order will have encouraged progressive effort and the development of original ideas.—*The Journal U. S. Artillery*, July, 1920.

LUX FIRE PREVENTION SERVICE.—A new system of extinguishing fires on board ships has lately been introduced into England, which method has met with considerable success in other countries, notably Norway and Sweden, and has the approval of the Norwegian and Swedish insurance companies,



Illustrating Lux Fire Prevention System

according to a foreign contemporary. The majority of the largest lines in these countries having already installed plants in their steamers and extracts from logs of ships in which fires have occurred show the successful working of the apparatus.

The patent is originally Swedish, being owned by the Aktiebolaget Lux of Stockholm, but licenses have been granted in most European countries; a description of the method of working of the system may, therefore, be of interest.

The system is based on the use of carbonic acid. This gas will, as is well known, extinguish fire by preventing the supply of oxygen, and has previously been used for this purpose in various ways, also in the liquid form, as is the case here, but the new method, it is claimed, has several advantages over those hitherto used.

In the "Lux" system the necessary quantity of carbonic acid is kept permanently in a liquid state under high pressure in ordinary steel gas-cylinders, which are preferably placed in the upper part of the ship. From these containers pipes lead under the deck to the various holds, branch connections being led down at suitable intervals close to the bottom of the holds. On the outbreak of fire the officer on duty turns on a valve, thus releasing the carbonic acid, and allowing it to pass to the pipe which leads to that part of the ship desired. The carbonic acid under high pressure immediately escapes into the hold and extinguishes the fire. The essentially new point in using liquid carbonic acid by the "Lux" system is, that it flows

from the containers to the fire in a liquid form. The following advantages are stated to be thus obtained:

1. The pipes can be made of as small a diameter as ½ inch and can be conveniently and securely placed along beams, joists or pillars.

2. The carbonic acid is immediately brought to the place where it is to be applied, by the pressure in the containers alone.

3. On its release from pressure the carbonic acid evaporates from the liquid to the gas form, thereby causing a tremendous drop in temperature in the room where fire has broken out. This is a point of great importance, as the cooling effect has the result of preventing a recurrence of the fire when the hatches are opened up later for inspection.

In comparison with water or steam, carbonic acid has great advantage as a fire extinguisher. Most kinds of cargo are destroyed by water or steam and in the case of a cargo of coal, as is well known, the pouring on of water or steam may increase the fire or even form explosive mixtures. On the other hand, carbonic acid is perfectly harmless to practically every class of cargo.

Carbonic acid has also the property of extinguishing burning petrol, benzine and other highly inflammable oils so that the system should be particularly suitable for oil-burning ships, tankers, etc.

The cut shows the position of the apparatus on board ship and pipe connections to the holds.—*The Nautical Gazette*, July 31, 1920.

THE SEA RECORD OF REINFORCED CONCRETE SHIPS.—*To the Editor of Engineering.*—" Sir.—Will you allow me, in the briefest possible space, to give some experiences of the behavior of concrete vessels which have been made known to me in recent days by owners.

" 1. A week or two ago, I was in the office of an owner and saw on his wall a photograph of a concrete ship very badly damaged. I remarked jocularly that he wasn't exhibiting his concrete ship in a very good light. On the contrary, he had put the photograph on his wall he said, because he thought it was a very good advertisement indeed for the concrete ship; for, he added, if a steel ship had been in a similar collision it would have cost, he reckoned, £4000 to repair, whereas the concrete vessel was repaired for £750.

" 2. I was shown by another owner, careful records, kept over a period of six months, of the upkeep costs of steel and concrete steamers of the same size and in the same trade, and working under the same conditions. *The concrete vessels cost one-fifth of the upkeep of steel vessels.*

" 3. I have a copy of a letter written by the skipper of a concrete vessel to the builder: " We left Swansea in a gale, when steamers would not sail, and for 24 hours, till we got to the Lizard, we had terrible weather; the puddling fenders and a few more things were missing in the morning but the ship stuck it well.

" 4. I have before me a letter from the managers of an American, 3500-ton concrete freighter who gave an extract from the log of their captain who made a special report on the vessel's performance between a Chilian port and the States: 'We ran into a gale from NE. with a velocity of around 65 m.p.h., on December 10, which lasted until December 12. During this gale there was a high sea running, and I must say I never in all my seagoing saw a ship act as gracefully and well. At times, large seas came at her looking as if they would come aboard, and the ship would rise every time, proving she had a great amount of buoyancy. I tried her in the trough and she rolled very easily.' "—*Engineering,* July 9, 1920.

CURRENT AND NAVAL PROFESSIONAL PAPERS

The White Oil Fuel System as Applied to the Cunard Liners *Aquitania* and *Olympic*. *Engineering,* July 2, 1920.

The Packard Aero Engine Type 2025. *Aerial Age Weekly,* July 19, 1920.

The Audion—Its Actions and Some Recent Applications. By Lee De Forest. *The Journal of the Franklin Institute,* July, 1920.

Tests on Auxiliary Condensers (Great Britain). *Engineering and Industrial Management,* July 1, 1920.

Trend of Thought in French Military Circles—The Cavalry—(Translation.) *The Cavalry Journal,* July, 1920.

The International Aero Exhibition. *Engineering,* July 16, *et seq.*

Some Experimental work in Connection with Diesel Engines. *Engineering,* July 23, *et seq.*

Practical Personnel Management. *Industrial Management,* August, 1920.

The Design and Construction of Mercantile Vessels in the Light of War Experiences. *Engineering,* July 9, 1920.

The Manufacture of High Grade Steel—Acid Open Hearth Process. *Engineering and Industrial Management,* July 22, 1920.

Testing Ventilating Appliances on Shipboard. *Engineering and Industrial Management,* July 22, 1920.

For Sale—The Panama Canal. *Sea Power,* July, 1920.

The Disposal of the Auxiliary Exhaust Steam in Marine Engine Practice. *The Shipbuilder,* July, 1920.

NOTES ON INTERNATIONAL AFFAIRS

FROM JULY 10 TO AUGUST 10

PREPARED BY

ALLAN WESTCOTT, Professor, U. S. Naval Academy

RESULTS OF SPA CONFERENCE

The Allied-German Conference at Spa closed on July 16. The German delegates after bitter opposition finally agreed to the Allied demand for the delivery of two million tons of coal a month for the next six months, Germany, however, receiving a credit which is likely to amount to 100 million dollars by virtue of the increased price of coal since the Versailles Treaty.

The reparations question was left for final settlement in the hands of a commission of experts from the Allied Powers and Germany. The Allies adhered to their threat to occupy the Ruhr Valley or other German territory in the event of non-fulfilment of the treaty terms.

THE POLISH-RUSSIAN CRISIS

POLAND SEEKS TERMS.—Placed in a critical situation by the Russian advance on Warsaw, Poland on July 22 sent an armistice proposal direct to the Moscow Government, at the same time reorganizing the Polish cabinet so as to secure Socialist support. In reply the Soviet Government agreed to negotiations, but at the first conference on July 30 no understanding was reached owing to the inability of the Polish delegates to act definitely without consulting their government.

The Russians continued their offensive during the armistice discussion, and on August 8 were bombarding the outer forts of Warsaw. Poland sent a second peace delegation with fuller credentials, and it was arranged that this delegation should enter the Russian lines on August 9 and begin armistice and peace negotiations at Minsk on August 11.

According to a statement issued by the Russian delegation in London on August 8, Russia was willing to accept the 1918 frontier established at Versailles. The delegation had received the following message from Moscow:

"Resultant on acceptance by Poland of the armistice terms, which will deal principally with reduction of her armed strength, the Soviet republic will be prepared to begin withdrawal of her troops to the line drawn by the supreme council in 1918 and indicated again by Earl Curzon (British secretary of state for foreign affairs) in his note of July 20 to Tchitcherin (Bolshevist foreign minister)."

ALLIED LIMITATIONS ON RUSSIAN DEMANDS.—Paris, July 30.—The limitations which Great Britain and France would put upon Soviet demands of

Poland in the arranging of an armistice are set forth in a notification which has been dispatched to the Warsaw Government by the British and French governments, it was learned here to-day. Poland requested the views of Great Britain and France on possible armistice terms, and the governments at London and Paris have notified the Polish Government that they will not permit Poland to accept possible Soviet armistice demands involving:

First—Whole or partial disarmament of Poland.

Second—A change in the Polish system of government dictated or brought about by the Soviets.

Third—Acceptance by Poland of a boundary line less favorable than that provisionally drawn by Premier Lloyd George.

Fourth—The use of Poland as a bridgehead, in any sense, between Germany and Russia.—*N. Y. Times,* January, 8.

ALLIED POWERS TO AID POLAND.—Following extended negotiations in an effort to mediate between Poland and Soviet Russia by means of a peace conference to be held in London, the Allied ministers met at Boulogne on August 8 to consider the question of direct aid for Poland, Prior to that date, on August 6, Premier Lloyd George proposed to Russia a 10-day truce on the following terms:

First.—The Poles to refrain from re-equipping their armies and moving troops and munitions and the Soviet to refrain from strengthening their front.

Second.—The Allies to refrain from sending troops or munitions to Poland.

Third.—Soviet representatives to be stationed at Danzig or any other point to see that the terms were carried out, on the condition that they refrain from propaganda.

Fourth.—The Russian and Polish delegates to meet to define lines between the armies and to arrange armistice conditions.

These terms the Soviets rejected, and the crisis thus created was regarded in French and British circles as second in gravity only to that of 1914. While no official declaration of war was contemplated, the Allies were resolved to give Poland all possible military, naval, and economic aid without delay.

LEAGUE OF NATIONS

LEAGUE ASSEMBLY TO MEET AT GENEVA.—Washington, July 15.—President Wilson has issued a call for a meeting of the Assembly of the League of Nations at Geneva, Switzerland, on November 15.

The call issued by the President has been sent to all nations which are members of the League, each of which will be entitled to representation in the Assembly.

The President's decision in favor of Geneva as the initial meeting place not only means that the first sessions will take place on neutral soil, but that the President has again indicated his disapproval of Brussels as the place for the permanent seat of the League. It will be recollected that the Allied Powers were at first in favor of the selection of the Belgian capital.

INQUIRY REGARDING ANGLO-FRENCH OIL PACT.—At the close of July the United States Department of State issued a notice regarding its attitude toward the recent agreement between Great Britain and France for the development and distribution of oil interests in mandate territories of the

two powers. Inquiries were made by the United States Government as to the character and scope of the agreement. The statement follows:

"The Department of State has received information that an Anglo-French petroleum agreement has been published by the British Government. The department has made representations to the British Government regarding certain provisions that apply to petroleum in mandate territories and is giving careful consideration to other features of the agreement."

In general the agreement provides that there shall be co-operation between Great Britain and France in the development and distribution of oil supplies in order to eliminate competition. The agreement is to be applied to all countries where the oil interests of the two nations may conflict and can be usefully united. Both governments are to act jointly to assist their nationals to obtain oil rights from the Rumanian Government, including enemy oil properties sequestrated by the Rumanian Government.

In most instances British and French interests are to be equally represented in the handling of oil properties. Mesopotamia, where British interests predominate, is to have 25 per cent of the properties developed by the British Government or by any Franco-British companies.

The agreement applies to the French colonies and British Crown colonies.

The United States Government is particularly interested in ascertaining whether the agreement is intended to give Great Britain and France superior rights in enemy territories for which the British and French governments have taken mandates. The United States holds that a government having a mandate for enemy territory has no commercial rights superior to those of other countries allied or associated with it in the World War. There has been some correspondence between the United States and Allied governments regarding the protection of American commercial interests in countries governed or to be governed by mandates authorized by the Versailles Treaty and the response received have satisfied officials of the State Department that no attempt is to be made to curtail American rights.

COUNCIL MEETING AT SAN SEBASTIAN.—The Council of the League of Nations met at San Sebastian, Spain, on July 30 and ended its sessions on August 5.

It was decided that the International Financial Conference under the auspices of the League would be held at Brussels September 24, Gustav Ador, former President of Switzerland, presiding. Unless a decision has been reached in the meantime regarding German reparations, that question will not be put in the order of business of the conference.

A permanent naval and military advisory committee was appointed to study and report upon questions of a military character upon which the League may be called upon to act. The commission is described, not as a "League general staff," but simply as a consultative body the principal mission of which will be to advise the league regarding restrictions upon the manufacture of arms and munitions.

TURKEY AND THE NEAR EAST

FRENCH IN SYRIA OVERTHROW FEISAL.—In mid-July, General Gouraud, commander of French troops in Syria, dispatched an ultimatum to Prince Feisal, the so-called King of Syria, demanding that he accept at once the French mandate, recognizing French as the official language, French money as the official currency, and French control over the railway from the seacoast to Aleppo. Though this ultimatum was accepted, the French forces

advanced to occupy the Damascus-Aleppo railway line for transport of supplies. On July 28 it was announced that the French authorities had severed all connection with Feisal and set up a new ministry under French control.

GREEKS ESTABLISH CONTROL IN THRACE.—A brief campaign of Greek forces against Turkish nationalists in Thrace ended on July 25 with the capture of Adrianople. Both in Thrace and in Asia Minor the Greek troops suffered slight losses,—in Thrace about 100 and in Anatolia a few thousand casualties.

DISPUTE OVER AEGEAN ISLANDS.—Paris, July 30.—A possible alteration in the Turkish peace treaty was discussed among the allied representatives to-day, owing to the controversy between Italy and Greece over the Dodecanese Archipelago in the Aegean.

This dispute has reached a point where the government of each country is refusing to sign the Turkish treaty unless the other will cede its claims to the islands. Both Premier Lloyd George and Premier Millerand are advising Italy to sign as an open convention the secret agreement, reached between Italy and Greece on July 29, 1919, under which the islands, with the exception of the Island of Rhodes, would go immediately into the possession of Greece. Premier Giolitti and Count Sforza, the Italian Foreign Minister, have up to the present time declined to be responsible for the agreement entered into by the then Foreign Minister, Tomasso Tittoni, last year, and recognized by subsequent Cabinets.—*N. Y. Times,* July 31.

TURKS SUBMIT TO TREATY TERMS.—On July 17 the Allied Powers answered Turkey's objections to the treaty terms by a statement that unless the Turkish Government ratified the treaty in 10 days, and furthermore asserted its power to enforce the treaty in areas under Turkish rule, the Allies would be compelled to consider the complete ejection of Turkey from Europe. No noteworthy modifications were made in the treaty terms.

The Turkish Government on July 21 decided to accept the conditions imposed and before the end of the month sent a new group of envoys to Paris to sign the treaty.

FAR EAST

AUSTRALIA AGAINST JAPANESE IMMIGRATION.—Paris, July 11.—Japan has found a new outlet for her population in Queensland and Australia and the opposition of the Australians to Japanese intrusion has increased to a dangerous point.

A recent law was passed by both houses of the Australian Parliament imposing a tax of $500 a head on Asiatic immigrants. It was sent to the Governor General for his signature, but under instructions from the British foreign office he refused to indorse the law.

The Australians do not want the Japanese for the same reasons that California does not want them. The only way out for the British Government is to form a new alliance which will take the place of the Japanese document in protecting England's Asiatic interests, and they believe America's future in the Far East will force her to follow the same course."—*N. Y. Times,* July 12.

INQUIRY AS TO JAPANESE POLICY IN SAGHALIN.—Despatches of July 28 announced the receipt by the Japanese Government of a note from the

United States making inquiries as to the purpose of Japan in occupying the northern half of Sahaglin and the adjacent main land. Though no information was issued by the American Department of State, it is understood that the note reiterated the opposition of the United States to the permanent occupation of any Russian territory by Russia's former allies, or to any action in the Far East that would involve a violation of the "open door" policy.

Early in July Premier Hara was questioned in the Japanese Parliament regarding the policy of his government in Siberia.

Premier Hara, replying, said it would be detrimental to Japan's interests to disclose what the government proposed to do if no satisfactory settlement of the Nikolaievsk massacre was found.

"Hattori fears occupation of Russian territory by Japan might leave indelible resentment on the part of the Russians," declared the Premier. "I share his fear, but think it impossible that Japan will do nothing to obtain satisfaction for a massacre in which 700 Japanese lost their lives, even though action is taken that may be productive of Russian resentment.

"As there is no stable government in Russia at present, there is no alternative but to occupy the necessary points in Saghalin province pending establishment of a legitimate government. The diplomatic world and history provide ample precedent for an injured country to take the steps it thinks proper. I am desirous that such a government as will give Japan satisfaction shall be established in Russia as quickly as possible."

JAPAN AND FAR EASTERN REPUBLIC REACH TERMS.—Honolulu, July 22.—Negotiations have been completed between Japan and Asiatic Russia regarding the creation of a buffer State in Siberia, a government memorandum issued in Tokio to-day announced, according to Tokio cables to Nippu Jiji.

Asiatic Russia has agreed to preserve peace to maintain friendly relations with Japan and abolish communism, while Japan has agreed to withdraw her troops from the buffer territory, and the European Bolshevist armies are to be barred from the territory, the memorandum was quoted.

LATIN AMERICA

BOLIVIA AND THE TACNA-ARICA DISPUTE.—The recent revolution in Bolivia which ousted President Guerra and put Savedra in power as provisional president has threatened a shift of altitude on the part of Bolivia in the long standing boundary controversy between Chili and Peru.

Bolivia lost her sea coast in war with Chili in 1873. After the war of 1879-83 between Chili and Peru, Chili also secured the coast provinces of Tacna and Arica, with provision for a plebiscite after 10 years to determine their ultimate disposition. Detailed arrangements for this plebiscite were not fixed at the time of the treaty, and the plebiscite has never been held. Chili, now confident that a vote would result in her favor, has insisted on the execution of the treaty and refused the proposals for international arbitration made by Peru.

Bolivia has hitherto sought the concession of a port and sea frontier by means of an understanding with Chili. It is now possible that she may favor concerted action with Peru. The dispute, which has caused increasing friction since 1915, is not simplified by the turn in Bolivian politics.

VILLA SUBMITS TO NEW MEXICAN GOVERNMENT.—Mexico City, July 28.—General Garcia, chief of staff of the War Office, announced to-day that the final terms of Villa's surrender had been decided upon.

The bandit chief will retire to private life in a place to be designated by the government. He will go first to Torreon to disband his forces, as he will retain no military connection whatsoever.

It is not likely that Villa will come to Mexico City, but will proceed from Torreon wheresoever the government directs.

The negotiations for the surrender have been conducted to the entire satisfaction of the government, Villa obeying all orders.

REVIEW OF BOOKS

ON

SUBJECTS OF INTERNATIONAL AFFAIRS

"Handbook for Naval Officers." (D. Van Nostrand Company, New York.)

The value of this compilation of questions and answers is evidenced by the popularity of the mimeographed notes which preceded it and which have passed from hand to hand among officers of the service when preparing for examinations for promotion. The book does not pretend to teach principles—and for complete knowledge of any one of the subjects treated, the student must necessarily seek treatises on the various specialties. It is a digest of information and as such, is of value to the initiated for brushing up and to the unitiated, may serve as a guide to study and practice.

S. E. H.

"The Navy Everywhere." By Conrad Cato. 297 pages. (Published by E. P. Dutton & Co., New York.)

This book contains a collection of interesting accounts of the activities of the British Navy in those theatres of the World War which were sufficiently remote to have escaped almost entirely the notice of the war correspondent of the press. The accounts are based upon official reports, from descriptive details by various officers who took part in the operations, and from the author's own experiences in some of them.

The book is divided into eight sections as follows:

(a) The Navy in East Africa.—The capture of Dar-es-Salaam, bottling up and destruction of the *Königsberg,* and an airman's adventures in connection with same.

(b) The Navy in the Cameroons.—Naval and military operations in the conquest of the Cameroons with interesting incidents in connection with same.

(c) The Navy in Serbia.—Account of the career of the British gunboat *Terror of the Danube,* and of the four British naval batteries co-operating with the Serbs during the disastrous invasion of Serbia by the Austro-German forces.

(d) The first kite-balloon ship.—Account of the H. M. S. *Manica* at Gallipoli and in East Africa.

(e) The Navy in the Persian Gulf.—British ships frustrate German land plans of native raids on coast towns.

(f) The Navy in Roumania.—The operations of British tanks, manned by the Royal Naval Air Service, in the battles of Topalul and Vizirul and in the retreat of the Allied armies from the Dobrudsha.

(g) The Aden Patrol.—Navy guarding Somaliland and the capture of a German raider.

(h) The Red Sea Patrol.—Capture of Salif.

Maps of the various theatres of operating are included. In addition, there are brief summaries of the political history of British activities in Persia and Somaliland which are generally not known.—The book is well written and the subject matter very interesting. Inasmuch as it covers operations of the Great War which are generally unknown this book will be found both instructive and entertaining.

O. O. H.

More members, both regular and associate, are desired. Any increase in membership invariably means a larger number of articles submitted, and consequently an improvement in the PROCEEDINGS.

You are requested to send or give the attached slip to some one eligible for membership, urging him to join.

By direction of the Board of Control,

H. K. HEWITT,
Secretary-Treasurer.

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Secretary and Treasurer,
U. S. Naval Institute,
Annapolis, Md.

Dear Sir:

Please enroll my name as a {*subscriber* / *regular member* / *associate member*} *of the U. S. Naval Institute from*.................. .

Very truly yours,

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For eligibility as to membership and for difference between members and subscribers see opposite page (Constitution).

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NOTICE

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It is now in its forty-seventh year of existence. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers upon subjects of interest to the naval profession, as well as by personal support.

On the subject of membership the Constitution reads as follows:

ARTICLE VII

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control. To be declared elected, they must receive the affirmative vote of three-quarters of the members represented at regular or stated meetings, either in person or by proxy.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control. The Board of Control will at each regular meeting ballot on the nominations submitted for election, and nominees receiving a majority of the votes of the board membership shall be considered elected to membership in the United States Naval Institute."

Sec. 8. The annual dues for regular and associate members shall be three dollars, all of which shall be for a year's subscription to the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, payable upon joining the Institute, and upon the first day of each succeeding January. The fee for life membership shall be forty dollars, but if any regular or associate member has paid his dues for the year in which he wishes to be transferred to life membership, or has paid his dues for any future year or years, the amount so paid shall be deducted from the fee for life membership.

ARTICLE X

Sec. 2. One copy of the PROCEEDINGS, when published, shall be furnished to each regular and associate member (in return for dues paid), to each life member (in return for life membership fee paid), to honorary members, to each corresponding society of the Institute, and to such libraries and periodicals as may be determined upon by the Board of Control.

The PROCEEDINGS are published monthly; subscription for non-members, $3.50; enlisted men, U. S. Navy, $3.00. Single copies, by purchase, 30 cents; issues preceding January, 1920, 50 cents.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ARTICLE, 1921

A prize of two hundred dollars, with a gold medal, and a life-membership (unless the author is already a life member) in the Institute, is offered by the Naval Institute for the best original article on any subject pertaining to the naval profession published in the PROCEEDINGS during the current year. The prize will be in addition to the author's compensation paid upon publication of the article.

On the opposite page are given suggested topics. Articles are not limited to these topics and no additional weight will be given an article in awarding the prize because it is written on one of these suggested topics over one written on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. All original articles published in the PROCEEDINGS during 1920, which are deemed by the Board of Control to be of sufficient merit, will be passed upon by the Board during the month of January, 1921, and the award for the prize will be made by the Board of Control, voting by ballot.

2. No article received after November 1 will be available for publication in 1920. Articles received subsequent to November 1, if accepted, will be published as soon as practicable thereafter.

3. If, in the opinion of the Board of Control, the best article published during 1920 is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention," or such other distinction as the Board may decide.

4. In case one or more articles receive "Honorable Mention," the writers thereof will receive a minimum prize of seventy-five dollars and a life-membership (unless the author is already a life member) in the Institute, the actual amounts of the awards to be decided by the Board of Control in each case.

5. It is requested that all articles be submitted typewritten and in duplicate; articles submitted written in longhand and in single copy will, however, receive equal consideration.

6. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

H. K. HEWITT,
Commander, U. S. N., Secretary and Treasurer.

TOPICS FOR ARTICLES

SUGGESTED BY REQUEST OF THE BOARD OF CONTROL

"Rebuilding the Navy's Enlisted Personnel, and Reestablishing Its Morale and Spirit After the Serious Slump Caused by too Rapid Demobilization and High Wages in Civil Life."
"The Human Element in the Administration of Discipline."
"A Demobilization Programme for the Future."
"The Mission of the Naval Academy in the Molding of Character."
"Health of Personnel in Relation to Morale."
"Physical Factors in Efficiency."
"The Naval Officer and the Civilian."
"Naval Bases, Their Location, Number and Equipment."
"Military Character."
"The Ability to Handle Men a Necessary Element in the Equipment of a Naval Officer."
"The Relation of Naval Communications to Naval Strategy."
"The Relation of Naval Communications to Naval Tactics."
"The Training of Communication Officers."
"The Organization of a Naval Communication Service."
"The Naval Policy of the United States."
"A Review of the Battle of Jutland with Lessons to be Learned Therefrom."
"Modification in the Design and Armament of Ships to Meet the New Conditions of Aerial and Subsurface Attack."
"Coordination of Surface, Subsurface and Aerial Craft in Naval Warfare."
"Our New Merchant Marine."
"Submarine Warfare, Its History and Possible Development."
"Escort and Defense of Oversea Military Expeditions."
"A Proposed Building Programme for the U. S. Navy, Including an Efficiency Air Service."
"Naval Organization from the Viewpoint of Liaison in Peace and War Between the Navy and the Nation."
"The Ship's Company—Its Training, Discipline and Contentment."
"The Principles of Leadership of Naval Personnel."
"Morale Building."
"The Value of Facility in Exposition—Verbal and Written—for Naval Officers."
"Discipline as Affected by the Human Relation."
"The Value of Pep."
"Navy Spirit—Its Value to the Service and to the Country."
"The Influence of the Term of Enlistment on the Efficiency of the Service."
"The Principles upon which Should be Founded the Freedom of Neutral Shipping on the High Seas."
"The Fighting Fleet of the Future."
"The Future of the Naval Officer's Profession."
"The Navy: Its Past, Present and Future."
"The Navy in Battle: Operations of Air, Surface and Underwater Craft."
"Shall I Remain in the Navy?"
"Psychology and Naval Efficiency."
"The Naval Policy of the United States in the Light of the Peace Treaty."
"Scope of Naval Industrial Activity and the Navy's Relation to Shore Industry."
"The Pacific Theater."
"Was Germany's Coast Impregnable?"
"Future Development of the Naval Shore Establishment."
"America as a Maritime Nation."
"Arguments for and against the Restriction of the Manufacure of Munitions to Government Owned Factories."
"The Present Rule of Neutrality regarding Contraband and Blockade—Is it Justifiable in Ethics or in Expediency?"
"The United States Navy and the League of Nations."
"Is a League of Nations *Navy* Desirable?"
"The Adaptability of Oil Engines to all Classes of War Vessels."
"The Place of Mines in Future Naval Warfare and the Rules under which Their Use Should be Allowed."
"The Use and Abuse of the Doctrine of Continuous Voyage."
"The Question of the Future Use of Submarines."

LIST OF PRIZE ESSAYS

"WHAT THE NAVY HAS BEEN THINKING ABOUT"

1879

Naval Education. Prize Essay, 1879. By Lieut. Commander A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut. Commander C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881

The Type of (I) Armored Vessel, (II) Cruiser Best Suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882

Our Merchant Marine: The Causes of Its Decline and the Means to Be Taken for Its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut. Commander F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883

How May the Sphere of Usefulness of Naval Officers Be Extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

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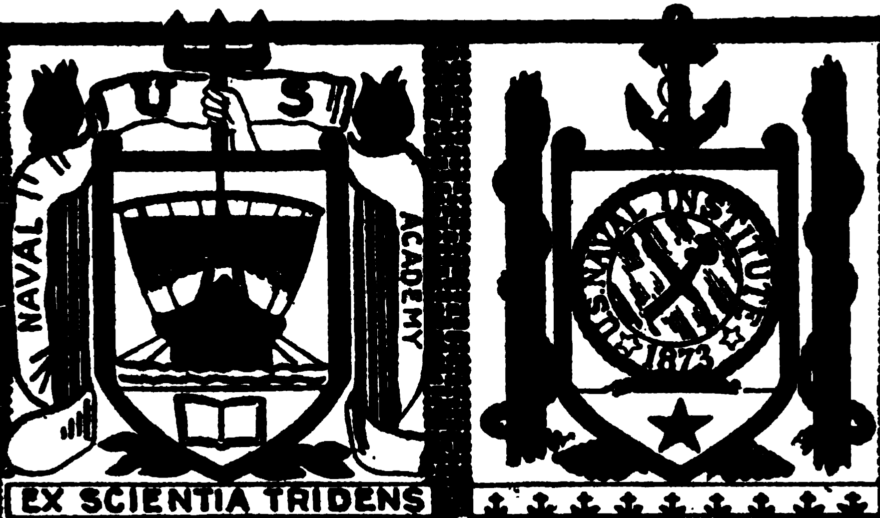

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AMERICAN PRODUCTION OF MILITARY HIGH EXPLOSIVES AND THEIR RAW MATERIALS

By Lieut. Commander Carleton H. Wright, U. S. Navy

When H. M. S. *Hampshire* was sunk by a German mine on June 5, 1916, Germany rejoiced and gloom pervaded England, for Lord Kitchener, the man on whom Great Britain relied for guidance and leadership in the great struggle, went down with the ship. Now, however, it is generally recognized that his death at that time was a most fortunate occurrence for Great Britain and her allies, for Kitchener in his capacity of Secretary of State for War controlled in large part England's production of munitions, and his failure to grasp the fact that under the new conditions of warfare high explosives must be produced and supplied to the armies in the field in unprecedented amounts had already cost the British forces dearly.

Before the outbreak of the World War none of the combatants had realized how great the use of high explosives would be, but the Germans and also the French had been quick to grasp the significance of the changed conditions, and had taken prompt steps to raise their production of high explosives to the maximum. The British armies in the field also early realized the importance of adequate supplies of high explosive shell, but their appeals for increased supplies met with but little response, for Kitchener had received his training under far different conditions and he could not realize the revolutionary changes that had taken place.

After his death Great Britain joined the other combatants in bending every energy toward increasing the production of high explosives. In order to augment the supply the various belligerents developed on a large manufacturing basis many explosives which had hitherto not been deemed worthy of consideration, and maintained a continuous search for new sources of supply. One result of the continuously increasing demand was that the Allies soon turned to the United States for additional supplies.

Prior to that time this country had not been a large producer of explosives adapted to military use, or even of the raw materials for their manufacture. We did, however, have vast undeveloped resources, and the high prices offered by the Allies greatly stimulated production, both of the raw materials and of the manufactured explosives. Principally because of the great saving of valuable cargo space, the Allies encouraged the manufacture of the finished explosives in this country rather than having us furnish them with only the raw materials. This policy resulted in the building of many new explosives plants here and the rapid expansion of those already in existence.

Thus American production of military explosives rapidly increased and the way was being prepared so that, upon our entrance into the war, the upward trend of production was merely greatly accelerated to meet the requirements of our own military and naval forces, while still continuing to furnish vast supplies to the Allies. Some idea of our expansion as a supplier of military explosives may be had from the fact that in 1914 we produced just a little over twenty-one million pounds of smokeless powder and other military explosives, while at the time of the armistice our production of high explosives alone was at the rate of seven hundred and twenty-five million pounds per year and that of smokeless powder was even larger.

At the present time while the record of our war achievements is fresh in our minds it is well to consider in detail our production of military high explosives, with a view to learn what production we may expect in case of need in the future; where the material for the manufacture of our explosives is to be obtained; and wherein our potential domestic supplies of raw materials should be developed to render us, so far as possible, independent of imports.

HIGH EXPLOSIVES

An explosive has been defined by Marshall as "a solid or liquid substance or mixture of substances which is liable, on application of heat or of a blow to a small portion of the mass, to be converted in a very short interval of time into other more stable substances, principally gaseous, with the evolution of a considerable amount of heat."

Substances of this type which are used by our military forces may be divided into two general classes, "progressive explosives" and "high explosives." The former are the so-called powders used to propel the projectile from the gun in the firing of small arms and cannon. Their rate of combustion when used as propellants is very much lower than the rate of detonation of the high explosives. The latter, which constitute the bursting charge of projectiles, torpedoes, submarine mines, etc., are designed to explode only when in the vicinity of the enemy and consequently a high velocity of explosion is desired to insure complete fragmentation in the case of projectiles, or in the case of underwater explosions the maximum blow upon the hull of the enemy ship. Practically speaking, no substance is considered as a military high explosive unless the velocity of detonation is at least three thousand meters per second.

The properties of high explosives which are of chief interest are the power, sensitiveness, velocity of explosion, and stability.

High power is of the greatest importance, since it is desired to get the maximum explosive effect from a given weight of explosive. In the case of shell fillers the density of the material, as affecting the power possible from the limited space available, is also of importance.

The degree of sensitiveness must lie within certain definite limits, depending on the use to which the explosive is to be put. The substance must not be subject to premature detonation from shocks it may receive in service, yet it must not be so insensitive that there will be danger of failure to function under the conditions it will encounter in action.

Closely allied to the question of sensitiveness is the subject of detonators and boosters. A detonator is an explosive used to initiate an explosion in another substance. Since the material in the detonator is always more sensitive than that in the main

charge the size of the detonator is always kept at the minimum consistent with proper functioning.

Usually a booster or boosters of material more readily detonated than the main charge is interposed between the detonator and the charge. The detonator first explodes the booster and then the latter explodes the main charge. It has been shown that improper detonators and boosters may not only cause complete failure to explode, but also result in incomplete detonation or "low order" explosions in other cases where outward appearances indicate satisfactory functioning. The modern tendency is to adopt as main bursting charges substances which are more and more difficult to detonate, and consequently the use of efficient boosters and detonators is becoming of constantly increasing importance.

The velocity of explosion and the closely related property, "brisance" which has been defined as the rate of increase to maximum pressure, are of great importance, for upon them depend the proper fragmentation of projectiles and the intensity of the blow in under water explosions.

An explosive for military use must be stable under the worst conditions it will encounter in storage or in service. An unstable explosive cannot be considered, because it may either fail to function when desired or else will be a source of danger in handling. It might even exhibit both of these undesirable attributes.

THE INFLUENCE OF SUPPLY ON THE CHOICE OF EXPLOSIVES

There are a rather large number of substances known to the chemists of the world which would be almost equally satisfactory as military explosives. The nature of the raw materials, the available supply of these materials, and the cost of the finished substance vary within wide limits, however, and the two factors of available supply and cost must govern the choice of explosives when other factors are even approximately equal.

Considerations of national safety demand that so far as possible the materials for explosives manufacture be articles of domestic production. When the difference in cost in favor of an explosive made from imported materials is great there will be a strong tendency, particularly on the part of some legislators, to favor the cheaper material, but this does not alter the fact that the

choice of an explosive made from imported materials is fundamentally unsound if a satisfactory explosive can possibly be produced from domestic supplies.

In case it is necessary to import materials for explosives, the location of the world supply must be considered. When any choice is available, it is obviously best to select a material the supply of which is not controlled by any one nation. Likewise a supply which is not subject to interruption because of stoppage of ocean-borne commerce is highly to be desired.

In the World War we find frequent examples of the use of explosives which are rather unsatisfactory from a military point of view, but their use was forced upon the belligerents because the normal supplies of raw materials were interrupted, or because the available supplies of the raw materials required in the manufacture of the explosives they preferred were inadequate to supply their needs. Examples of such substitutions are the use of wood cellulose instead of cotton by the Germans and the use of nitroethane, trinitrocresol, trinitronaphthalene, etc., by the Allies.

The price of raw materials is of course regulated to a large extent by the age old law of supply and demand. Under the heading of supply must be considered not only the extent but also the location of the world's supply, for the Germans have shown in the dye industry, the potash industry, and the like, that a nation which is favored with natural advantages can, if she so desires, manipulate prices in such a manner as practically to prohibit the development of natural resources in other countries. A consideration of available resources must also take into account the purity of the materials as found, for the manufacture of explosives requires materials of a very high state of purity, and the cost of purification may eliminate from consideration the supply of material from certain sources.

Non-military demands for the same material required for the manufacture of a certain explosive, or for similar material, may favor or may operate against the adoption of that particular explosive. If the supply is insufficient to meet the normal demands the price will probably be prohibitively high. Upon the other hand, the demand from commercial sources may cause the development of new sources of supply, and thus favor the adoption of that explosive, particularly if the new sources of supply are domestic. Many of the materials most satisfactory for the

manufacture of explosives are by-products of other industrial processes, and naturally increased demand for the principal products of the process renders the by-products available in increased quantities and at attractive prices.

In any consideration of the sources of supply of raw materials it is essential that due attention be given to the fact that rapid progress is being made in the accumulation of chemical knowledge, and that new chemical processes are being developed which may practically revolutionize an industry. A most notable example of this as affecting explosives is the development of processes by which benzol may be used as the raw material for the manufacture of picric acid. The discovery of such a process vastly increased this country's possible production of high explosives.

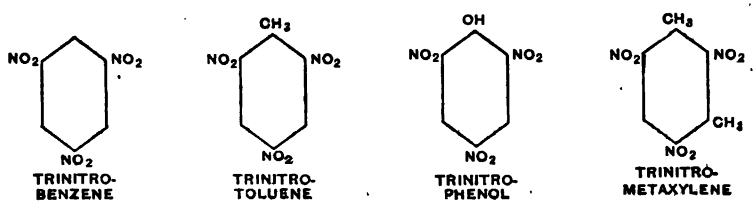
Even more revolutionary is the development of synthetic methods for the fixation of atmospheric nitrogen in Germany. It is worthy of note that as soon as these methods had been developed to a point of quantity production, rendering Germany independent of nitrates from Chili, she plunged the world into war. In marked contrast to this, it is known that at the time of the Agadir incident the German chemists informed the rulers of the empire that war could not be successfully waged until such synthetic processes had been developed, and consequently hostilities were at that time avoided.

THE PRINCIPAL HIGH EXPLOSIVES MANUFACTURED IN THE UNITED STATES

During the World War, as has previously been stated, large quantities of smokeless powder and high explosives for the Allies were manufactured in this country. In this paper only the production of high explosives will be discussed, for this is the branch of the explosives industry that made the most startling advances after we entered the war as a combatant. Since one of the objects of this article is to see what quantity of high explosives this country is capable of producing in case of emergency, the amounts of material made for the Allies will be included in the totals to be given hereafter. Although the Allies favored some explosives that have never been liked by our own forces, it is probable that in case of need in the future our production would follow the same general lines that it did in the late war.

The principal high explosives manufactured here for military use will be discussed separately:

1. *Nitrated Aromatic Compounds.*—Most of the modern high explosives are in whole or in part the product of the nitration of the aromatic compounds formed principally in the destructive distillation of bituminous coal. The most satisfactory of these explosives are the products of the trinitration of substances having a single benzene nucleus, *e. g.*, trinitrobenzene, trinitrotoluene, trinitrophenol, and trinitroxylene. It should be noted that in all of these the isomer most readily formed, and the one most stable of all those possible, is the one in which the three nitro groups are symmetrically arranged around the benzene ring:



Mono- and di-nitro bodies are ordinarily not in themselves satisfactory as high explosives, but they are used extensively in mixed commercial explosives, and to some extent in mixed military explosives, particularly in France and Germany. They have not been used to any important extent in military explosives in this country.

(*a*) *Trinitrobenzene.*—Trinitrobenzene is a very satisfactory high explosive, but because of the difficulty of nitrating benzene and the low yields obtained, its manufacture is so expensive as to be prohibitive. Toluene, phenol, and xylene are nitrated much more easily than benzene, as the presence of a substituent in the benzene ring facilitates the entrance of other substituents.

(*b*) *Trinitrotoluene.*—The widespread use of trinitrotoluene is indicated by the number of names under which it is known. The principal of these are TNT, trinitrotoluol, trotyl, tritolo, trinol, and trilite.

Although this explosive has only recently come into general use it has been waging a winning fight against picric acid for favor as a shell filler, and against guncotton for use in mines and torpedoes.

TNT is slightly less powerful than picric acid, but this disadvantage is more than outweighed by several distinct advantages. First of these is the fact that TNT, unlike picric acid, does not form sensitive salts when in contact with the heavy metals. Second is the fact that nitration of toluene is considerably easier than that of phenol, and the yield considerably nearer the amount that should theoretically be obtained. Still another advantage is the lower melting point of TNT, enabling it to be much more easily cast direct into shell cavities, etc.

TNT is used for bursting charges of projectiles, both by itself and mixed with other substances; for main charges of submarine mines, torpedoes, depth charges, and bombs; and it is also used in boosters. In addition it enters into the manufacture of many mixed explosives, the principal ones in this country being amatol and toxyl.

During the war, in spite of our rapidly increasing production, the supply of TNT was never equal to the demand. The limiting factor in our production throughout our participation in the war was the lack of a supply of toluene sufficient to supply our needs.

In Fig. 1 is shown our increasing production in 1918. For purposes of comparison the production in August, 1914, and April, 1917, is also given.

For the manufacture of one pound of TNT the following raw material is required: Toluene, 0.068 gal.; nitric acid (100 per cent), 1.11 pounds; sulphuric acid (100 per cent), 0.31 pounds. Besides these, alcohol and benzene are required in the purification by crystallization.

(c) *Picric Acid and Ammonium Picrate.*—Like TNT, trinitrophenol or picric acid is known under various names in different countries. The most common of these are P. A., lyddite, melinite, shimosite, and pertite.

Until recently picric acid or its ammonium salt were almost the only substances used by the nations of the world as a shell filler. Even now it is more extensively used for this purpose than any other material, and will no doubt continue to be for some time in the future, because the raw materials for the manufacture of picric acid—phenol and benzene—are available in great quantities.

Picric acid itself is a very satisfactory explosive for use in projectiles in practically all respects except one—that it forms

extremely sensitive salts when in contact with the heavy metals, especially lead. In recent years few serious accidents have occurred from this source because proper precautions have been taken to avoid any opportunity for the formation of such salts, but the necessity for care is always present.

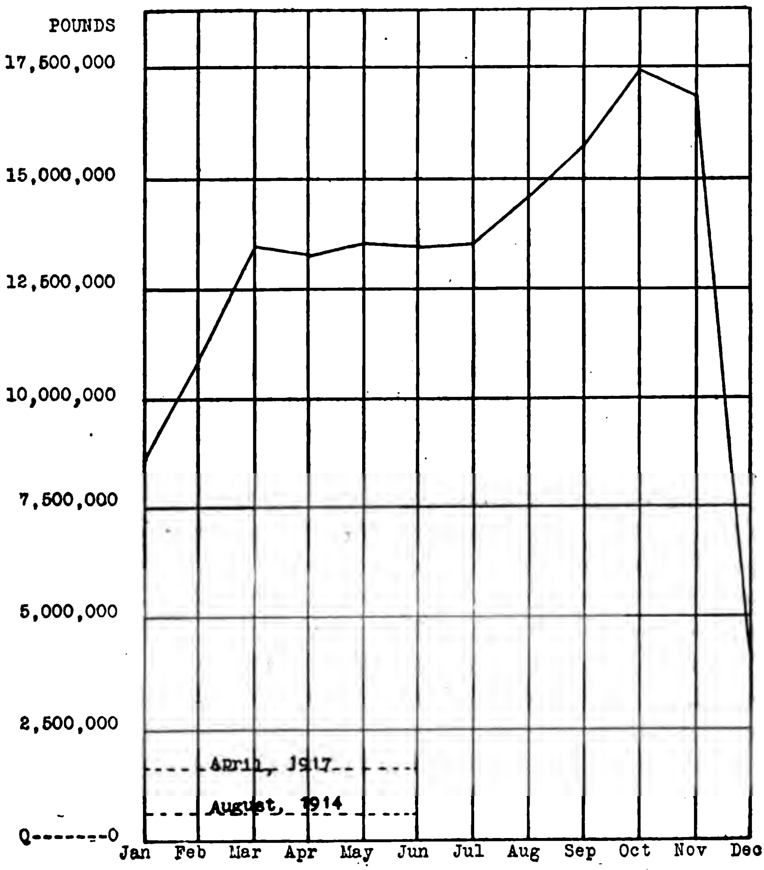


FIG. 1.—TNT Production, 1918.

Ammonium picrate is also a satisfactory explosive. The advantage in the use of ammonium picrate in place of picric acid is the reduction of the danger of the formation of metallic picrates.

Picric acid itself has never been adopted as a military high explosive in this country, but it has been in great demand in Europe, particularly on the part of France. When the Allies

turned to us for an augmentation of their supplies in 1915 the prospect of their receiving much assistance looked far from promising. To begin with, all picric acid was at that time made from phenol and we had never produced even enough phenol to satisfy our own requirements for the supply of commercial needs. The war naturally stopped exports to us from the belligerents and an acute shortage existed. In order to supply the phenol required in the synthetic manufacture of the resin used in making phonograph records, the Edison research laboratory began the study of synthetic methods for the manufacture of phenol from benzene. Within a very short time they had perfected such a process, and a plant was built with sufficient capacity not only to supply all their needs but to leave a large excess for sale.

Here was the Allies' opportunity, but the alert German organization under Dr. Albert was quicker to see the possibilities than they were, with the result that a contract was signed requiring the delivery of all phenol made in excess of the requirements of the Edison Company to firms designated by Dr. Albert's agents. These firms, which were subsidiaries of the great German chemical houses, converted the phenol into salicylic acid, perfumes, flavoring extracts, and other products which were useless to the Allies in their search for explosives. This operation not only netted the German organization a profit of more than eight hundred thousand dollars from the sale of the products they manufactured, but what was much more important to them, it prevented the manufacture of more than four and one-half million pounds of picric acid which the Allies would otherwise have secured.

Consequently the Allies had to await the construction of other synthetic phenol plants, and the development of the by-product industry before they could obtain large supplies of picric acid in this country. Production of picric acid for them on a large scale began in 1916, however, and we contributed important supplies both before and after we entered the war. In the later stages of the struggle production was not limited by shortage of raw material as only a small part of our total production of benzene went into the manufacture of picric acid.

Fig. 2 shows graphically our production of picric acid in 1918. Practically all of this was for delivery to the Allies, especially

the French, whose demands for this explosive seemed to be almost insatiable. The production of picric acid in the United States prior to the World War was negligible, with the little being made used largely as a dye.

In Fig. 3 is shown our production of ammonium picrate in 1918. Our production of this material in 1914 was also hardly

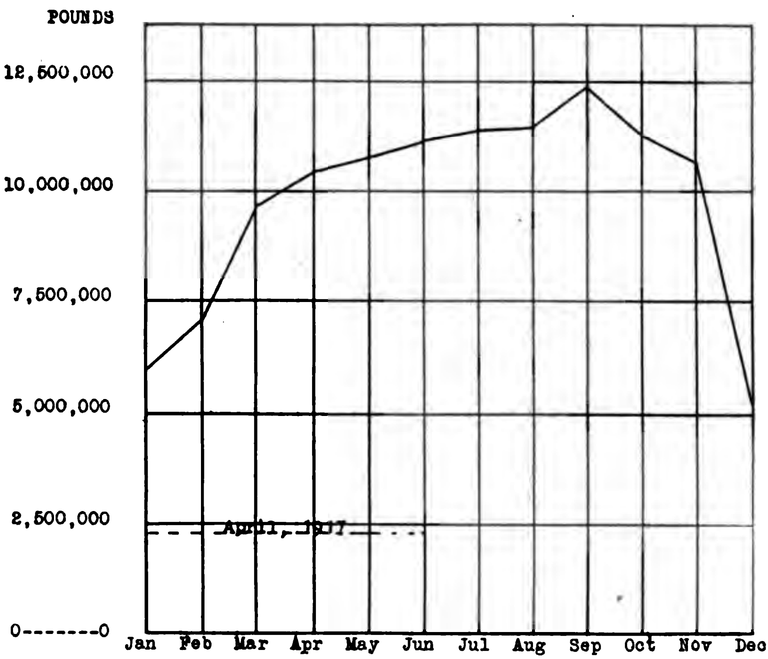


FIG. 2.—Picric Acid Production, 1918.

worthy of mention. Our rate of production at the time we entered the war is given for the purpose of comparison.

For the manufacture of one pound of picric acid the following material is required: Phenol, 0.566 pounds (the equivalent of 0.110 gal. benzene and 2.20 pounds of 100 per cent sulphuric acid); nitric acid (100 per cent), 1.34 pounds; sulphuric acid (100 per cent) 2.01 pounds.

For the manufacture of one pound of ammonium picrate the following is required: Picric acid 0.99 lb.; and ammonia 0.084 lb.

(d) *Trinitroxylene.*—From[1] its physical properties trinitroxylene or TNX would appear to be most unfavorable for use as a military high explosive. The melting point of the predominat-

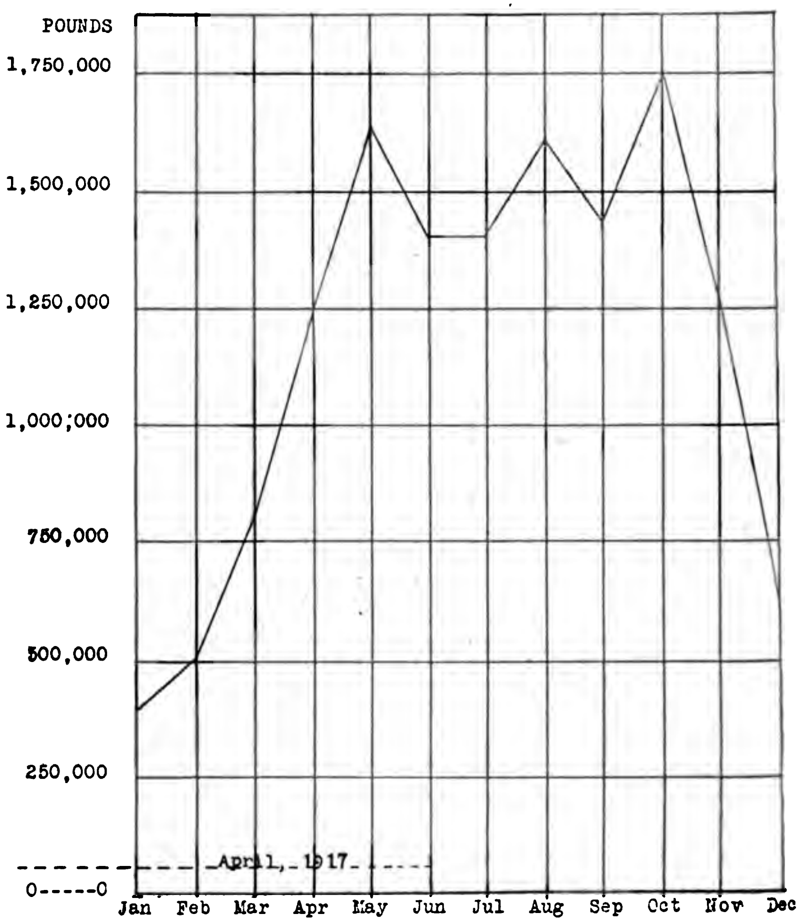


FIG. 3.—Ammonium Picrate Production, 1918.

ing isomer is very high, 182° C., making it impossible to load by direct casting. Moreover this compound is almost insoluble in other lower melting point nitro bodies at low temperatures, such as are preferable for casting, seemingly precluding the

[1] Marshall, Jour. Ind. and Chem. Eng., Mch., 1920.

casting of such a mixture. It has not more than 80 per cent the strength of TNT and it is much less sensitive to detonation.

The acute situation which developed in the TNT supply in the summer of 1917, however, made it necessary to consider the use even of material which appeared unfavorable. Under these conditions the du Pont Company began experiments with mixtures of TNX with TNT in cast charges.

Rather to the surprise of those concerned, TNX proved to be almost ideal for the purpose. When 30 to 50 parts of TNX were suspended in 70 to 50 parts of TNT at 100° C., a sufficiently fluid mass was obtained to permit direct casting. The castings when cooled proved to be non-hygroscopic, free from air holes, and without segregation of the components. The cast mixture could be detonated with smaller boosters of tetryl than were required for refined TNT, and the tests showed an explosive force approaching that of straight TNT. Moreover it was found that purification of the TNX was not necessary as the crude material was just as satisfactory as the refined.

Consequently immediate steps were taken to develop a manufacturing process for use in large scale production. As this was nearing completion negotiations were entered into with the Navy Department, which eventually resulted in the drawing of a contract requiring the delivery of 2,500,000 pounds of TNX each month beginning with December, 1918.

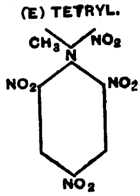
Work was promptly begun on the construction of the plant and at the time of the armistice two of the five units of the plant were in full production and the other three either nearing completion or in partial production. A total of only 228,000 pounds of TNX was delivered, but it is certain that the large supply of this material which would have been available had the war lasted even a few months longer would have been most welcome.

Except in case of national emergency, the manufacture of TNX will not be carried on, for it is not so satisfactory an explosive as TNT, but the perfection of the manufacturing processes on a full scale is a distinct national asset, for we are now enabled, in case of future need, practically to extend our TNT supply by one-fifth.

Materials required for the manufacture of TNX are xylene (free from paraffines and naphthenes), nitric and sulphuric acids,

and sodium carbonate. The exact amounts can not be given, since the information belongs to the Du Pont Company.

(E) TETRYL.



Tetryl or trinitrophenylmethylnitramine is extensively used as a booster, as it has been found to be a most satisfactory substance for this purpose in the detonation of TNT and other nitro aromatic compounds. The high cost of its manufacture prevents its use as a main bursting charge, although it would otherwise be satisfactory for this purpose.

Because of its use being limited to the loading of boosters, the quantity of tetryl required is naturally much smaller than that of the other nitro aromatic compounds previously discussed.

Prior to the World War the amount of tetryl made in the United States was negligible. Before we entered the war considerable quantities were made for the Allies, but the really rapid increase in production was not made until 1918. Our production in that year is shown in Fig. 4.

For the manufacture of one pound of tetryl the following material is required: Dimethylaniline, 0.45 pounds; sulphuric acid (100 per cent), 4.47 pounds; nitric acid (100 per cent), 3.87 pounds.

NOTE.—One pound of dimethylaniline requires two pounds of aniline and 0.23 pound of methyl alcohol for its manufacture.

(f) *Other Nitro-Aromatic Compounds.*—Many other nitro-aromatic compounds are explosive substances, and some of them were used by European nations during the World War. Probably the most important of these are trinitrocresol, trinitroanisole, trinitronaphthalene, and tetranitroaniline, used principally by the French and Russians; and hexanitrodiphenylamine, used by the Germans in mixture with TNT as a bursting charge for torpedoes and mines. The first two of these have been tried out on a small scale in this country, but found unsatisfactory. The expense of manufacture of all except the nitrated naphthalenes has been very great in comparison with TNT, and none of them have sufficient advantage over TNT to displace it as a main bursting charge in this country. Just prior to the armistice the manufacture of tetranitroaniline was, however, begun in the United States. The plant and equipment were already in existence, having been built to manufacture this material for the Russians before we entered the war. As tests had shown it to be practically

as efficient as tetryl for boosters, manufacture was begun with the idea of augmenting our supply of material for boosters.

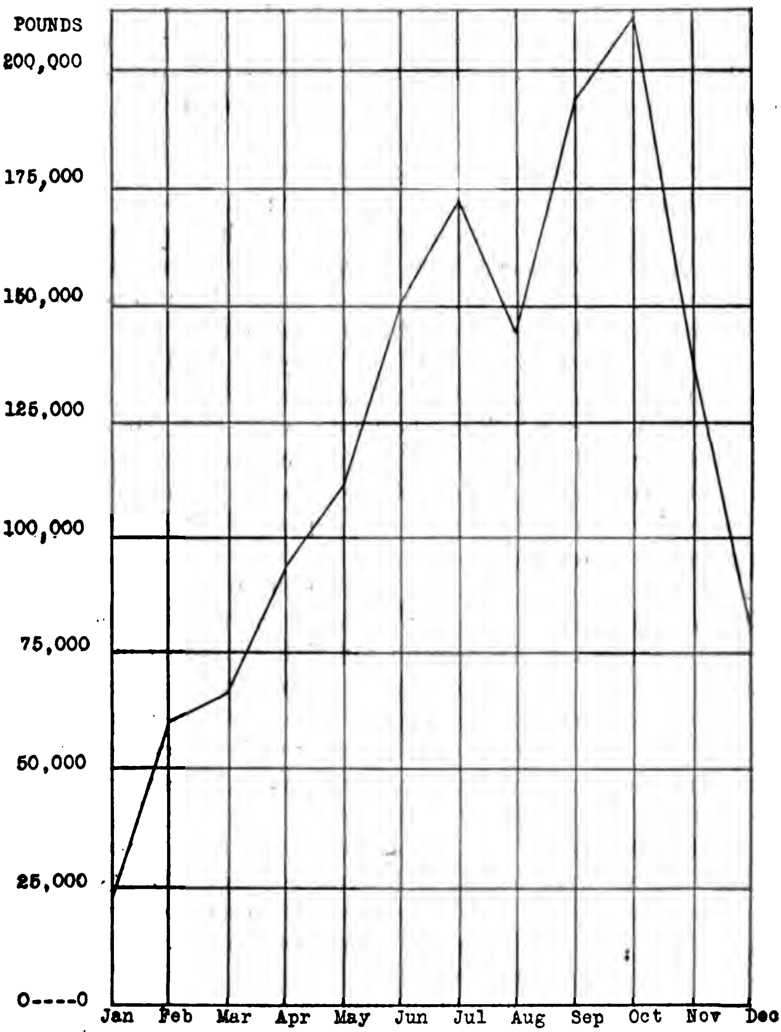


FIG. 4.—Tetryl Production, 1918.

About 8000 pounds were delivered, but none of this was used because of the cessation of hostilities.

Just recently the Du Pont Company has perfected a process for the manufacture of hexanitrodiphenylamine from dinitromono-

chlor benzene and analine, which gives a very high yield at low cost. Hexanitrodiphenylamine has been shown by test to be more efficient than Grade "A" TNT as a booster, and almost equal to TNA and tetryl for this purpose. As it is more stable than either of the latter, and the new method of manufacture makes it very much cheaper than other satisfactory booster materials, it seems probable that the future will see us using hexanitrodiphenylamine in large quantities in the loading of boosters.

Another high explosive which may in the future be extensively manufactured here, is parazol, or dinitroparadichlorbenzene. In the manufacture of phenol or of picric acid from benzene the first stage is the formation of monochlorbenzene by the action of chlorine gas on benzene. At this stage a considerable quantity of dichlorbenzene, mostly para, is always formed, in spite of efforts to obtain the maximum yield of the monochlor body. The paradichlorbenzene which is otherwise a waste body can easily be nitrated to the dinitro stage. The product, parazol, is a stable body which can, when mixed with TNT, be detonated. The result of such detonation is a high order explosion with evolution of large quantities of poisonous gas.

2. *Non-Aromatic Explosives.*—Although recent years have seen the rapid rise to a position of first importance of the nitro-aromatic explosives, the demand for high explosives in the late war was so great that the production of the other high explosives also increased rapidly. In time of peace the non-aromatic explosives are manufactured in great quantity for commercial uses, while the use of the nitro-aromatic compounds for such purposes has in the past been relatively unimportant.

(a) *Ammonium Nitrate.*—The principal of these explosives of other than aromatic origin, at least in point of quantity manufactured for military use in the late war, is ammonium nitrate. In the United States its principal use was as a constituent of "80-20" amatol (80 per cent NH_4NO_3, 20 per cent TNT), which was extensively used as a shell filler.

Ammonium nitrate is not so powerful as the principal nitro aromatic high explosives, is hygroscopic, and is prone to give low order explosions; but it appears to be the only shell filler that can be produced in sufficient amounts to supply our needs.

The cost is low because of the relative cheapness of the raw materials and the simplicity of the processes of manufacture. It

may be prepared by simply neutralizing nitric acid with ammonia, or by double decomposition between ammonium sulphate and sodium nitrate. The simplicity of the manufacturing operations greatly facilitates rapid increase of production in case of necessity.

Ammonium nitrate is a constituent of an important class of dynamites, and consequently our production of this substance in

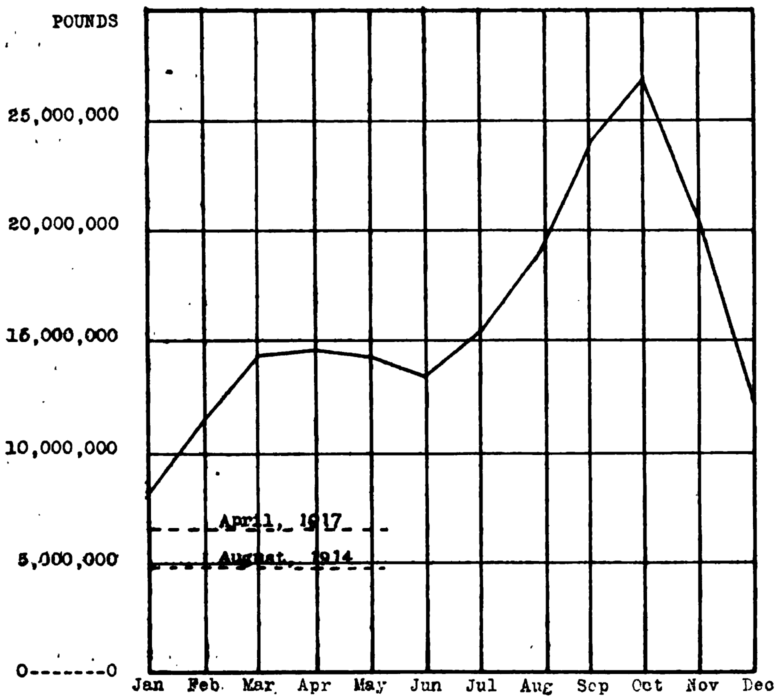


FIG. 5.—Ammonium Nitrate Production, 1918.

1914 was of respectable proportions. Our extremely rapid increase in production in 1918 is shown in Fig. 5. For purposes of comparison our production in 1914 and at the time we entered the war is also given.

The material required for the manufacture of one pound of ammonium nitrate by the neutralization process is: Ammonia, 0.23 pound; nitric acid (100 per cent), 0.813 pound.

(b) *Nitroglycerine.*—In time of peace nitrogylcerine is made in greater quantities than all other high explosives. In time of

war it is still of great national importance because of the extensive use of dynamite in the essential industries, but it is not adapted to military use and is not a constituent of any important military high explosives. It is however an important component of the so-called "two-base" (nitroglycerine-nitrocellulose) type of smokeless powders, such as cordite, which many other nations use as propellants. As such it does not, however, properly come within the province of this article.

(c) *Gun Cotton.*—Gun cotton and nitroglycerine were both discovered in 1846, and for many years they were the only important high explosives. Until recently gun cotton was used almost universally as the main charge for mines and torpedoes. Now, however, the nitro-aromatic compounds, especially TNT, have largely replaced it and gun cotton has become of minor importance as a military high explosive.

Considerable amounts were made in this country during the war, but this was almost entirely for delivery to the Allies. Unlike the other high explosives used for military purposes it shows no material increase of production in 1918, the average being a little over 2,100,000 pounds per month, and the October production being actually less than that in July.

Gun cotton is less powerful and less brisant than TNT, and it is subject to slow deterioration, particularly when it is in the dry state, which necessitates frequent inspection and constant vigilance. It is safe to state that it will be unimportant as a military high explosive in case of future wars.

Material required for the manufacture of one pound of gun cotton is: Cotton, 0.70 pounds; sulphuric acid (100 per cent), 0.68 pound; nitric acid (100 per cent), 1.12 pounds.

(d) *Nitro Starch.*—In the early stages of the war, because of the apparent shortage of TNT and NH_4NO_3 then existing, it was necessary to develop an explosive for filling grenades, trench mortar shell and drop bombs. To meet this need the Trojan Powder Co. developed a nitro-starch explosive which was adapted to this use. Nitro-starch explosives had been under investigation by other manufacturers for a number of years, but the difficulties incident to the manufacture and purification of nitro-starch had not previously been overcome.

The Trojan Powder Co., operating under a secret process, overcame these difficulties and all nitro starch explosives used

in the war were made by this company, although another nitro-starch explosive, manufactured by the Du Pont Co., was developed during the war and authorized for use.

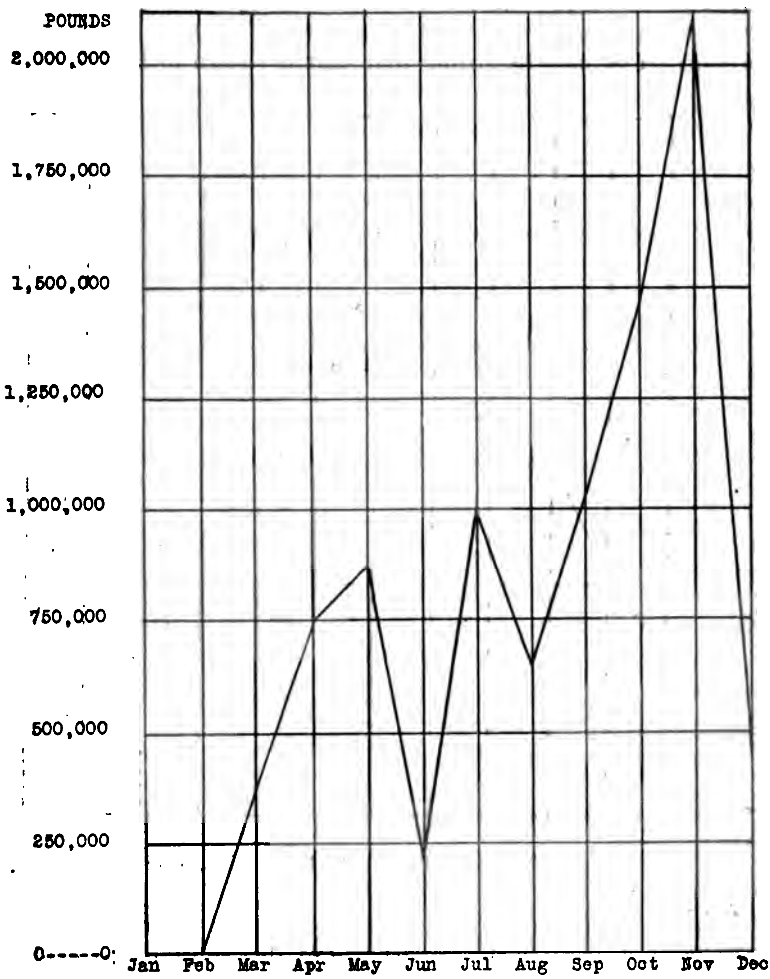


FIG. 6.—Trojan Powder Production, 1918.

Our country was the only one that used nitro-starch explosives during the war, but the results obtained in service were so satisfactory that there is reason to assume that if similar need were to arise in the future nitro-starch explosives would again be used by

us for filling grenades, and for similar uses. The cost of the raw materials is low, and the use of these materials does not interfere with the manufacture of other types of explosives.

No nitro-starch explosives were manufactured, except in experimental lots, in this country prior to the year 1918. Our production by months during that year is shown in Fig. 6.

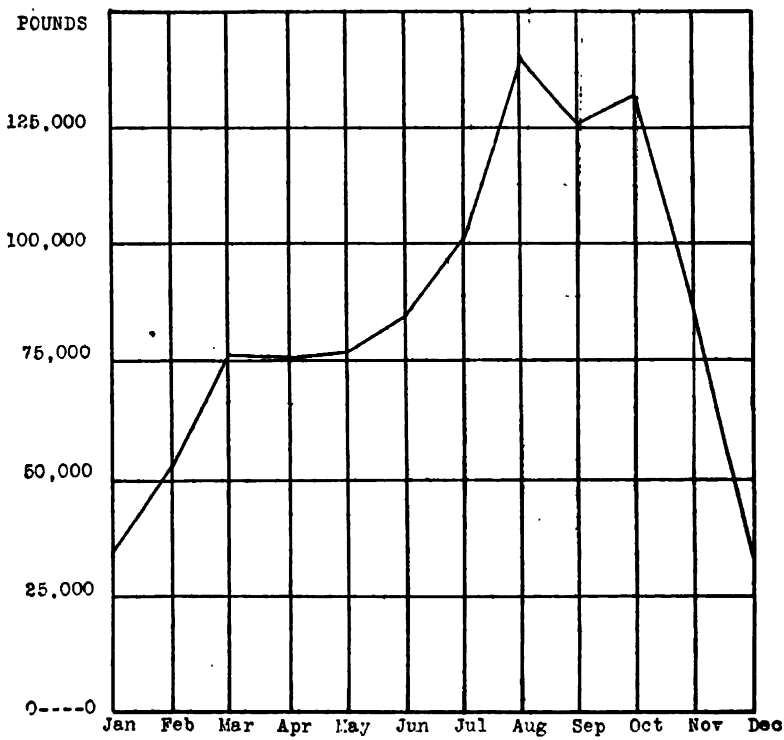


FIG. 7.—Mercury Fulminate Production, 1918.

(e) *Fulminate of Mercury.*—Although the quantity of fulminate used is small, the importance of this substance is evident from the fact that the detonation of every one of our high explosive shells, torpedoes, mines, and bombs is dependent upon the proper functioning of the fulminate in the detonator.

Nobel's discovery of the peculiar ability of fulminate to initiate a high order explosion in nitroglycerine was the first step in the development of high explosives. Since his time fulminate has

continued to hold its place as the most satisfactory initiator of high explosions that has ever been found. In some European nations lead azide, PbN_6, has recently been used to replace fulminate, but the use of azide has not found favor in this country.

Fulminate is also used extensively in mixture with other substances in primers for guns to initiate the ignition of the propelling charge. Other nations continue this use, but here the failure of ammunition so primed to function satisfactorily, caused the substitution of non-fulminate mixtures, and the one now in use has given much more satisfactory results.

Prior to the World War, production of fulminate in the United States was very small, as our high revenue tax on ethyl alcohol rendered the cost of manufacture almost prohibitive in competition with imported fulminate. In 1918 our production was increasing rapidly, as shown in Fig. 7.

For the manufacture of one pound of fulminate of mercury the following material is required: Mercury 0.77 pound; nitric acid (100 per cent), 4.42 pounds; ethyl alcohol, 5.88 pounds.

MATERIALS REQUIRED IN THE MANUFACTURE OF ALL HIGH EXPLOSIVES

Nitration,[2] whether of an aromatic compound or of cotton or glycerine, is always carried out with a mixture of sulphuric and nitric acids, and not with nitric acid alone, for even the strongest nitric acid does not act well by itself. One of the main functions of the sulphuric acid is to combine with the water formed during the reaction and prevent its diluting the nitric acid, but it appears probable that it also takes an active part in the reaction, and that to some extent at any rate, it combines first with the substance to be nitrated to form a sulphuric ester or sulphonic acid, and that it is this which is afterward acted upon by the nitric acid. That this two stage nitration is what probably takes place is shown in the nitration of phenol, for it has been found that with this material the best results are obtained by first acting on it with sulphuric acid with the formation of phenol sulphonic acid, and then as a second stage of the process to act upon the latter with nitric or mixed acids, when picric acid results.

[2] Explosives, A. Marshall, 1917.

In all nitration the use of sulphuric acid makes the nitration not only more complete, but also much more rapid.

In the process of nitration important amounts of acid are consumed. The quantities of acid previously stated as required in the manufacture of the various explosives are the average figures from our explosives plants in 1917 and 1918. The consumption of acids in the manufacture of explosives in most foreign countries is even higher, a French official estimate of their requirements being "sulphuric acid 4 to 5 times the weight of the explosive, nitric acid 2 to 3 times the weight of the explosive."

1. *Sulphuric Acid.*—Sulphuric acid is made from pyrites, zinc blende, or sulphur by the "chamber process" or the "contact process." In both of these processes the first stage is to burn the sulphur or sulphur-containing ore in an excess of air, converting the sulphur to sulphur dioxide. It is then necessary to make the sulphur dioxide combine with a further quantity of oxygen to form sulphur trioxide, which when combined with one molecule of water forms sulphuric acid.

In the chamber process the extra oxygen is added by mixing a small quantity of oxides of nitrogen, added in the form of spray or with a steam jet, with the sulphur dioxide.

In the contact process the sulphur dioxide and a considerable excess of oxygen are passed over a platinum catalyzer, which brings about the conversion to sulphur trioxide.

A disadvantage of the chamber process as a means of manufacturing sulphuric acid in time of war is the fact that it uses up considerable quantities of nitric acid, which can not well be spared from the supply available for nitration in the manufacture of explosives. In addition, the contact process is the one best adapted to the production of pure concentrated acid and oleum, as required for the manufacture of explosives. For this reason most of the large explosives plants now make their acid by the contact process.

Before the war a large part of the sulphuric acid manufactured in this country was made from pyrites imported from Spain. During the war the difficulties of transatlantic transportation greatly reduced these imports and our own resources were rapidly developed to take care of the market formerly supplied by Spain, as well as of the steadily increasing demand from the Allies and from our own industries. The principal increases in production

were from the pyrites mines of Virginia and the sulphur deposits of Louisiana and Texas. The field in the latter two states, made

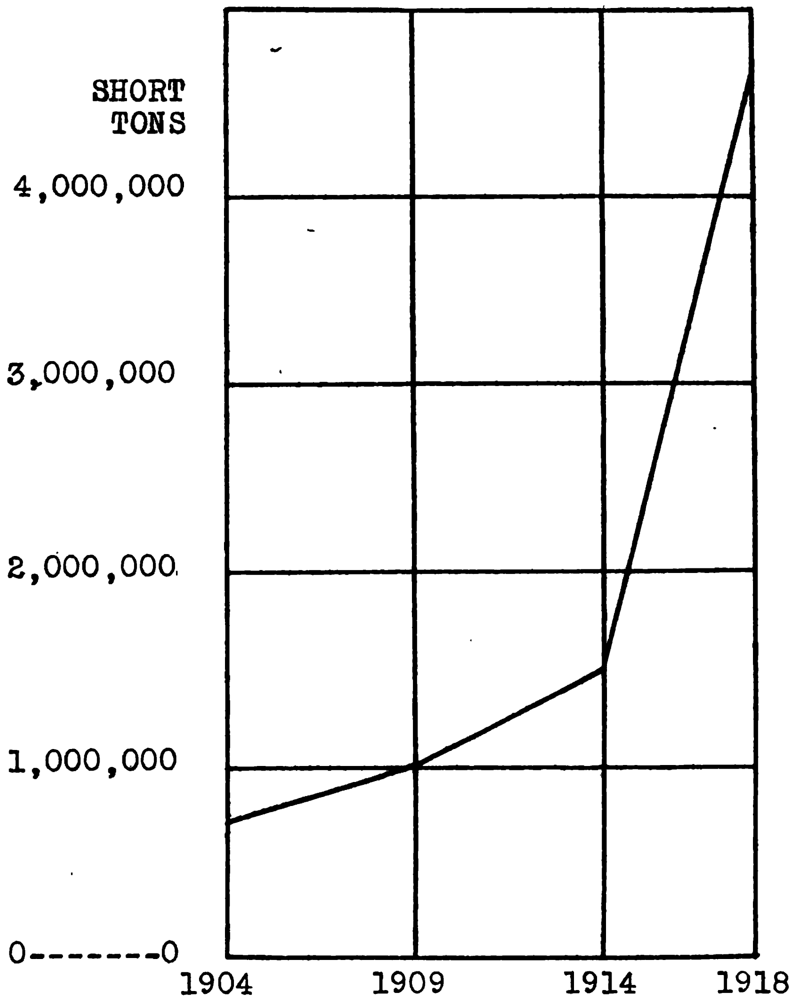


FIG. 8.—Sulphuric Acid Production. (Reduced to 100 Per Cent Acid Basis.)

workable through the ingenuity of an American engineer, now supplies the raw material used in the manufacture of most of the high grade acid made in this country. Our supplies of sulphur

are much larger than those of any other nation, and our plant facilities have been increased until our possible production of the acid is now more than three times what it was before the war.

The consumption of this acid in the industries other than the manufacture of explosives is very large. Even in 1918 when our production of explosives was at its maximum, less than one-fourth of the sulphuric acid made was used in explosives manufacture. At this time our national production of the acid was about 450,000 short tons per month (all strengths reduced to a basis of 100 per cent acid) and approximately 100,000 tons were used in the explosives industry.

Because of the consumption of sulphuric acid in the industries it has been stated that "the extent of a nation's civilization can be judged from the amount of sulphuric acid it manufactures." Certainly the industrial progress of a nation can be accurately judged in this way. Our tremendous production of sulphuric acid corresponds with our commanding position among the industrial nations of the world.

The increase in our manufacture in recent years and the result of the war demands for this acid, both from explosives plants and other industries, are shown in Fig. 8.

2. *Nitric Acid.*—If the industrial progress of a nation can be judged from the amount of sulphuric acid she produces, her ability to defend herself from her enemies can even more surely be judged from the amount of nitric acid she is capable of producing, for no satisfactory military explosive has ever been made, from the date of the first discovery of black powder down to the present time, that did not contain fixed nitrogen. Since practically all the nitric acid made in this country is made from sodium nitrate imported from Chili it is evident that here is an extremely grave source of national weakness.

The first form of fixed nitrogen used in the manufacture of explosives was potassium nitrate, also known as saltpetre. It is formed in the decomposition of animal and vegetable matter under favorable conditions. Deposits of saltpetre are formed in considerable quantities only in thickly populated countries which are sufficiently warm to accelerate the decomposition, and which have a long dry season during which the deposit can collect without being washed away. Of course these conditions are not found anywhere in the United States.

True saltpetre remained the chief source of fixed nitrogen until about 1850 when sodium nitrate (Chili saltpetre) began to take its place. The consumption of Chili saltpetre has steadily increased and to-day it is the only important source of nitric acid for the principal nations of the world except Germany.

Mention has previously been made of the development of synthetic methods for the fixation of atmospheric nitrogen by the Germans. This development was probably the most important accomplishment of Germany in preparation for the World War.

It has long been known that the nitrogen and oxygen of the air would combine in the intense heat of the electric arc, but the power requirements are so high that the manufacture of nitric acid by this process is usually not economically practicable except in countries like Norway and Iceland where large amounts of electric power can be obtained at very low cost. The arc process for the fixation of nitrogen has been developed on a large scale only in Norway.

Other methods for the fixation of atmospheric nitrogen have been developed, and two of these were used in Germany to supply her with the nitrates essential for her explosives and for her agriculture. In the older of these processes, the cyanamide process, calcium carbide is first formed. This when heated in an atmosphere of nitrogen gas, secured from a liquid air apparatus, is converted into calcium cyanamide, $CaCN_2$. The cyanamide when heated with steam in autoclaves is converted into calcium carbonate and ammonia. The latter can then be oxidized to nitric acid.

In the second process, the Haber process, nitrogen and hydrogen are made to combine directly to form ammonia by passing the mixed gases in the proper proportions over a catalyzer at high temperatures and pressures. The ammonia is then oxidized as in the cyanamide process.

Both of these processes have been developed on a very large scale in Germany, so that she is now in a position not only to supply her own needs, but also to sell a large surplus to other countries in competition with Chili saltpetre. If permitted, Germany will undoubtedly resort to her old methods of price cutting so as to prevent the development of synthetic nitrate manufacture in other countries where investigation of the subject is now under way.

In the United States more than one hundred million dollars was spent in the construction of nitrogen fixation plants during the war, but the processes have not yet been perfected on the large scale attempted. Since the armistice almost no advance has been made in the way of production, and progress is now practically at a standstill awaiting a decision from Congress as to the disposition to be made of the plants. In the meantime private capital hesitates to enter the field because of doubt as to the future of the government plants, and question of the ability to compete with imports of nitrates from the natural deposits in Chili and from the fixation plants already well established in Germany.

The seriousness of our dependence upon imports is evident from the fact that in 1918 we imported 60 per cent of all the sodium nitrate produced in Chili. Our 1919 explosives program would have required the consumption of 2,246,654 long tons of sodium nitrate or its equivalent, and this is only 600,000 tons less than the maximum annual production from the Chilean fields. Assuming that we could have obtained the amount we would have required from this source, it is apparent that the Allies, who are also dependent upon this source of supply would have been in desperate straits. Our own agricultural interests would also have suffered severely from the shortage of nitrates for use as fertilizers.

It is evident that it is necessary as a matter of national safety to establish the nitrogen fixation industry in this country so that in case of future need we will not be dependent upon imports of a material which is an absolute essential in the manufacture of explosives for our fighting forces, and of fertilizers which are essential if the people of this country are to be clothed and fed.

Another potential source of nitric acid is the by-product ammonia produced in our gas works and coking plants. The by-product coke ovens now constructed have a working capacity of 179,320,000 pounds of ammonia annually. If all of this were to be oxidized to nitric acid, 382,564 short tons of acid would be produced. This is the equivalent of 535,590 long tons of sodium nitrate. Of course all the ammonia could not be spared for such conversion to nitric acid, because of the extensive use of ammonia in the essential industries, and in the manufacture of ammonium nitrate and ammonium picrate.

The rapid increase in the production of nitric acid in 1918 to supply the demand in the manufacture of explosives is shown in Fig. 9. In contrast with sulphuric acid, nitric acid is used in comparatively small amount in other industries. In 1918 more

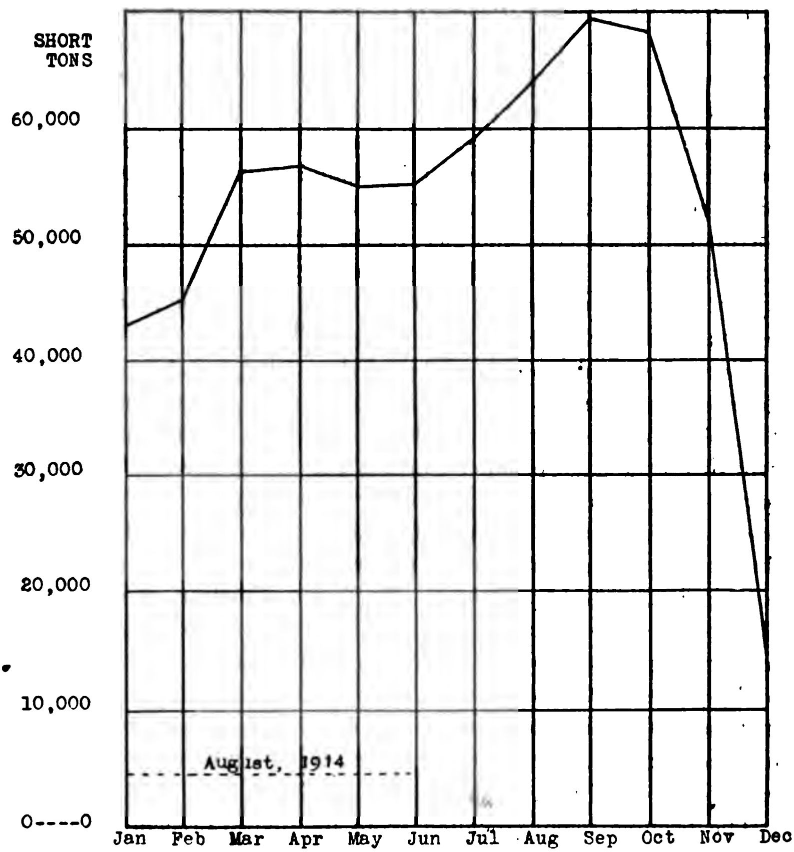


FIG. 9.—Nitric Acid Production, 1918.

than 95 per cent of the total consumption was in the manufacture of explosives.

For the manufacture of one pound of 100 per cent nitric acid from sodium nitrate the following material is required: Sodium nitrate, 1.57 pounds; sulphuric acid (100 per cent), 1.46 pounds. Some manufacturers use much more nitrate than this, but the

above figure represents the average result in efficiently operated American plants.

OTHER MATERIALS REQUIRED FOR ONE OR MORE OF THE IMPORTANT HIGH EXPLOSIVES

1. *Coal Distillation Products.*—The coal distillation products used in the manufacture of most of the important high explosives are by-products in the manufacture of coke in by-product ovens, and of the manufacture of coal gas for city distribution. In both of these processes the essential chemical operation is to decompose certain special grades of bituminous coal by heating to a high temperature out of contact with air. The main products of the operation are coke and gas; the by-products are ammonia and coal tar. In the coal tar are the benzene, toluene, phenol, cresol, xylene, and other aromatic hydrocarbons used in the manufacture of explosives.

Since these substances are by-products, the quantity produced depends not primarily on the demand for them, but on the demand for coke and gas, particularly the former. As more than 80 per cent of all the coke produced in this country is used in blast furnaces in the manufacture of pig iron, it is very fortunate that under the conditions of modern warfare the iron and steel industry is working at maximum capacity, for the increased demand for pig iron naturally results in greater production of coke, and also of the by-products so essential for the manufacture of modern high explosives. In the late war, however, our recovery of by-products was not half what it could have been had other methods of coking been used in the plants equipped with beehive coke ovens. This type of oven wastes not only all of the valuable by-products, but also all of the gas.

The beehive oven, so-called from its shape, preceded the by-product oven in the coke industry of this country by many years, and occupied a commanding position with a production of more than twelve million tons of coke per year when the first by-product oven was built in 1893. The number of by-product ovens increased slowly, and it was not until 1912 that the by-product production of coke equalled that obtained from the beehive ovens in 1893. In the meantime the production of the latter had more than trebled.

Among the reasons for the beehive ovens retaining the lead in production were: the fact that it was first in the field; that large supplies of natural gas were available near the principal fields, making the manufacture of coal gas unprofitable; that the supply of coal was abundant and very cheap; and that the market for the by-products in this country was extremely limited.

Unlike the beehive ovens the by-product ovens were generally not built in the immediate vicinity of the coal mines, but rather were located in the vicinity of industrial works where a profitable market for the gas could be found.

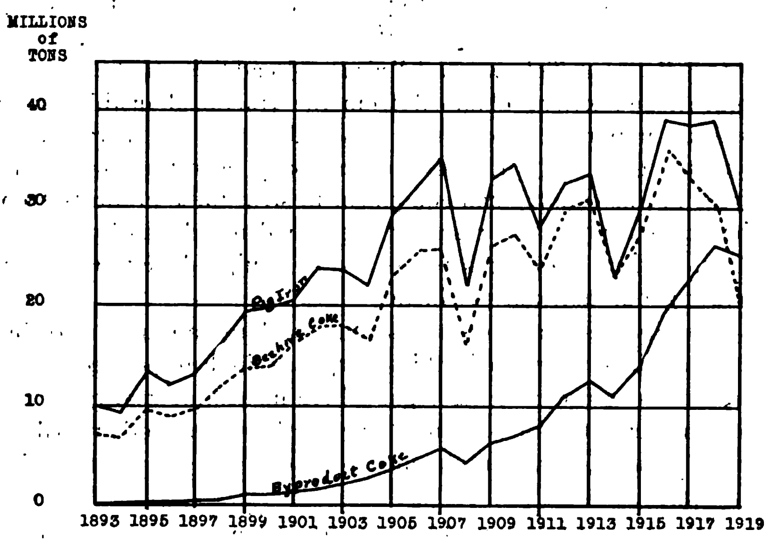


FIG. 10.—Beehive and By-Product Coke.

With the gradual depletion of the supplies of natural gas, and the increased demand for the by-products, particularly when the Allies turned to this country for explosives, conditions changed even in the vicinity of the coal fields, and the construction of by-product ovens in large numbers was energetically begun. The change to this type of oven has been so rapid that in 1919, for the first time in history, the output of coke from our by-product ovens was greater than that from the beehive type.

The growth of the two types of ovens in the coke industry, and the production of pig iron corresponding is shown in Fig. 10. It will be noted that the production of beehive coke varies the

more markedly from year to year, and is the more sensitive to variations in our pig iron production. Although the beehive capacity is still the greater, the tendency is for the by-product ovens to work at nearly full capacity to carry the normal load, and for the beehive type to be called upon only for the "peak load." It seems but natural to suppose that future increase of capacity, and necessary replacement of old ovens will be accomplished by the construction of more by-product ovens, and that in the not very distant future the beehive type will cease to be an important producer of coke in this country. Certainly this condition is to be hoped for, to prevent further waste of materials so necessary to our national safety.

(a) *Benzene, Toluene, and Xylene.*—In addition to the benzene, toluene, and xylene obtained from the fractional distillation of coal tar, important amounts of these substances are carried away with the gas. In 1914 only one company operating by-product ovens in this country had equipment to strip these products from the gas, but now, as a result of the war demands, all by-product plants and most city gas plants are so equipped, thus vastly increasing our national production.

The city gas plants do not produce as large an amount of by-products in proportion in this country as in Europe, because of the extensive use of "water gas" here instead of coal gas. Important quantities of benzene, toluene, phenol, and other coal tar products were, however, obtained from our city gas plants during the war.

The supply of toluene from by-product ovens and gas plants was never sufficient to supply the demand for TNT, and consequently other possible sources of supply were diligently investigated.

The first and most important of the processes to obtain toluene from other sources than coal distillation was that developed by the General Petroleum Company of Los Angeles, California. In their process a yield of six per cent of toluene was secured from a distillate from certain California bituminous base petroleums, by subjecting this distillate to high temperature while under great pressure. Two plants were built to operate on this principle. Their combined rated capacity was 3,000,000 pounds of toluene monthly.

Two other cracking processes, one known as the "Rittman" process and the other known as the "Hall" process, were investigated and production of toluene from solvent naphtha was conducted on a small scale by each of these processes while hostilities lasted.

With the present low price of toluene it is extremely doubtful that it would be profitable to make it by any of these cracking processes, but the methods are now available as a means of increasing our supply if the need ever again arises.

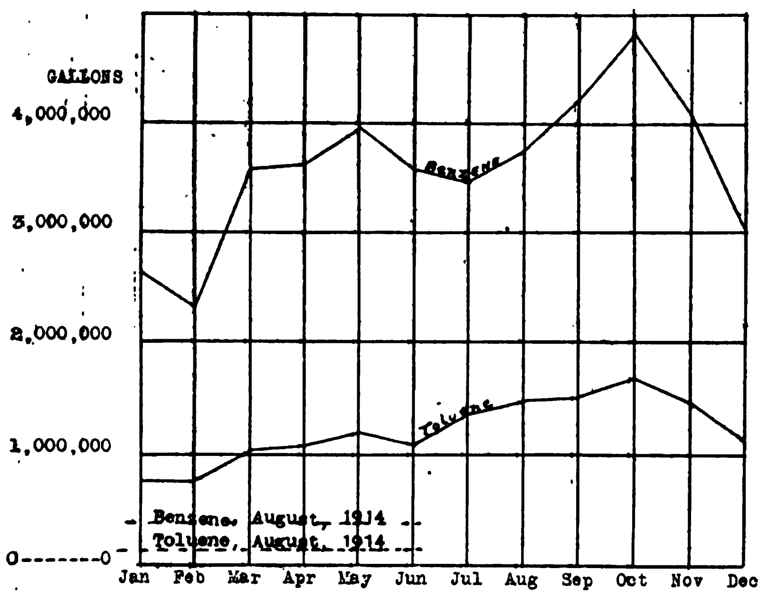


FIG. 11.—Benzene and Toluene Production, 1918.

The great increase in our production of benzene and toluene from all sources is shown in Fig. 11. This increase was brought about mostly by the rapid increase in the number of our by-product ovens and the installation of apparatus for the scrubbing of gas. The maximum possible recovery of xylene has never been made, because this material was not used in the manufacture of explosives until the closing days of the war. It is estimated that we can count on a production of xylene about one-fifth as great as that of toluene.

(b) *Phenol.*—The coal tar acids, phenol and cresol, are present in much larger amounts in the tar from coal gas works than in that from by-product ovens or water gas plants. In Europe, and especially in England, a much larger proportion of coal gas tar is available than in the United States, because of the lesser use of

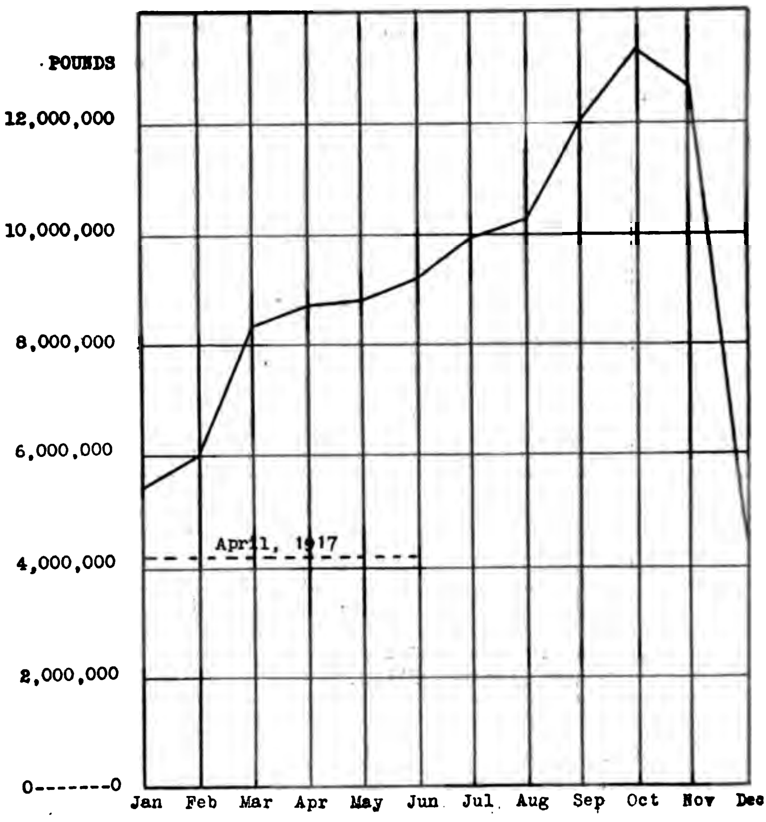


FIG. 12.—Phenol Production, 1918.

water gas there in illuminating gas plants. This accounts for the fact that natural phenol to the extent of about 8,000,000 pounds annually was regularly imported from Europe before the war. As has been previously mentioned, the cutting off of our imports combined with the great demand for picric acid caused the rapid development of synthetic manufacture of phenol from benzene. Our production of phenol from coal tar also naturally increased

with the expansion of the by-product industry, but during the war by far the largest part of our phenol was made synthetically. Our production of phenol in 1918 is shown graphically in Fig. 12.

(c) *Ammonia.*—The distillation of coal is now the only important source of ammonia. Naturally the expansion of the by-product coking industry in recent years resulted in greatly increased production of ammonia. Our rapidly rising production of ammonia in 1918 is shown in Fig. 13.

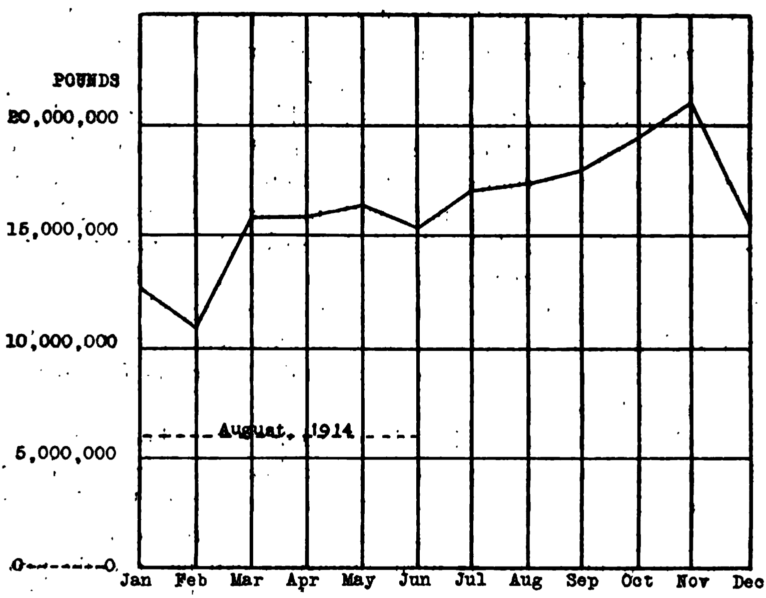


FIG. 13.—Ammonia Production, 1918.

(d) *Commercial Uses for the Coal Distillation By-Products.*—It is evident that these so-called coal tar products will not be available in sufficient quantities to satisfy our needs for explosives in case of future war unless the demand for them in time of peace is sufficiently great to make it profitable to operate plants for their recovery. It is therefore profitable to survey the uses to which they are now put. The first class of compounds that generally occurs to the mind in connection with coal tar products is dyes. The[3] close relation between dyes, explosives, and poison

[3] Census Dyes and Coal Tar Chemicals, Fed. Trade Com., 1918.

gases is of the greatest importance from the military point of view, because the dye factory can be quickly converted into an explosive or poison gas factory in an emergency, using the same staff, materials, and apparatus, with only slight modifications which are easily and quickly made.

The relation between picric acid and sulphur black, the dye ranking first in point of quantity production in this country, is particularly intimate, the manufacture of these two products from benzene being identical until the last step. It is evident that a plant making sulphur black in peace times can quickly get into production of picric acid in case of emergency. The plant has the entire process, with the exception of the last step, in actual operation, and the chemicals for this last step are ready at hand. The equipment needed for the final process can also be kept at hand with a comparatively small outlay of capital. Additions to the plant may be made with maximum speed, as all the technical problems and details of design of the apparatus must necessarily have been worked out in advance, and therefore no time need be lost in experimenting or in making plans. Moreover such a plant will already have an experienced staff capable of quickly absorbing and training additional workers for operating a much larger plant.

A relation similar to that discussed above, although not so close, exists between TNT and the various dyes derived from toluene. The relation is, however, close enough to be of great military importance. These as well as other nitro-aromatic compounds in military use as high explosives can be speedily produced in large amounts by a nation with a well developed dye industry, but only with much more difficulty and considerable loss of time by a nation without a dye industry. The propellant, fulminate, and dynamite branches of the explosives industry do not have as close a relationship to the dye industry as does that branch dealing with the nitro-aromatic compounds.

It is well known that these military considerations have received great weight in the development of the German dye industry and that the relatively small amount of equipment required for the conversion of their dye factories into explosives plants was ready at hand.

In the United States to-day certain chemical plants which were erected during the war to manufacture explosives and poison

gases have already been converted into dye or intermediate plants, or to other peace-time purposes. This procedure in America is a complete reversal of the procedure in Germany at the outbreak of the war.

Another important point to be considered in connection with the relationship of the dye industry of a nation to her potential production of high explosives is the fact that the dye industry encourages the researches of a large number of skilled organic chemists with the resultant knowledge of organic compounds that is of invaluable assistance in the wartime development of the explosives industry.

Other important uses for coal tar products are the manufacture of synthetic drugs, tanning materials, artificial flavors and perfumes, photographic chemicals, and phenolic resins. The development of these industries is a distinct military asset, both because the chemical processes and plants can be readily adapted to the production of explosives, and because a commercial demand for the raw materials in time of peace encourages the installation of by-product ovens which will insure an ample supply of the raw materials required for explosives in time of war.

The present production of benzene and toluene is so great that the price has fallen to about twenty-four cents per gallon for the former and twenty-six cents for the latter. At these prices they are finding extensive use as fuels for internal combustion engines being substituted either in whole or in part for gasoline.

Both of these materials are also being extensively used as substitutes for turpentine as a thinner for paints and varnish. They are also used as a paint remover, as solvents for many organic substances, particularly rubber, and as raw material in the manufacture of certain varieties of artificial leather.

The uses of ammonia in industry are many and varied. The greater part of our production in times of peace is used in the manufacture of fertilizers, and in the refrigeration and chemical industries.

The high boiling fractions of coal tar distillation, not suited to the manufacture of explosives, find extensive use as wood preservatives, road surfacing materials, and in the manufacture of roofing materials. The pitch left behind after the distillation of the tar is a very pure grade of carbon, and as such is extensively used in the manufacture of electrodes.

These many and varied uses of the materials recovered in the by-product ovens seem to insure the continued increase of this type of oven in the future.

2. *Cotton.*—In 1918 almost twenty per cent of our total crop of cotton was nitrated in our explosives plants, but less than one twenty-fifth of this went into the manufacture of guncotton, the remainder being used in the manufacture of smokeless powder. In view of the decreasing importance of guncotton as a military high explosive there seems to be no reason to fear that our supply of cotton for the manufacture of this material will ever be inadequate.

3. *Mercury.*—In spite of the rapidly increasing production of fulminate, the total amount of mercury consumed in its manufacture is but a small part of our national production. In 1918 more than 36,000 tons of mercury was produced in the United States and only 390 tons were used in fulminate manufacture.

4. *Ethyl Alcohol.*—Ethyl or grain alcohol is obtained principally by the distillation and rectification of the product of fermentation of fruit juices, molasses, and the sugar produced by the action of the diastase in malt upon the starch in grains and vegetables.

Our distilleries can easily be adapted to the production of high proof alcohol, and fortunately the eighteenth amendment to the Constitution does not prohibit the manufacture of alcohol for other than beverage purposes. The manufacture of grain alcohol is, however, so heavily taxed, and the requirements of our laws so exacting, that the price to the consumer is greatly increased.

As the consumption of alcohol in industry is increasing in spite of the restrictions upon its sale and use, production is increasing to keep pace with the demand. Since there is every reason to expect a continuing increase in consumption and production, particularly in view of the fact that alcohol may some day compete with gasoline as a motor fuel, we may confidently count upon a supply of alcohol sufficient to satisfy our needs in the manufacture of high explosives. The quantity required for this purpose is insignificant in comparison with the amount used in the manufacture of our smokeless powder.

5. *Methyl Alcohol.*—Methyl or wood alcohol is obtained by the dry distillation of wood. Our forest resources are still so great that there is no apparent danger of a lack of the small

amount of wood alcohol used in the manufacture of high explosives. However, when one considers the many uses of our forest products, such as the varied uses of paper and of articles made from paper pulp; the wide variety of materials known under the general classification of "naval stores"; and the multitudinous uses of lumber in our industries, he is at once impressed with the fact that the rapid destruction of our forests is a national calamity, and that prompt steps toward reforestation are essential to our future prosperity.

6. *Starch.*—This nation is one of the largest producers of starch-containing cereals and vegetables and should consequently have no fear of lacking the relatively small amount of starch required in the manufacture of nitro-starch explosives. It is true that only certain varieties of starch have been successfully nitrated, and that special methods of purification are necessary, but the experience of the late war demonstrated that plants for the production of the starch desired could be erected and put into operation with sufficient rapidity to insure an ample supply for the nitro-starch factories.

7. *Chlorine.*—Chlorine gas was used by us in large quantities during the World War in the manufacture of picric acid from benzene. Most of our chlorine comes from plants engaged in the manufacture of soda by the electrolytic process. The chlorine gas which was formerly a most objectionable waste product is now used in the manufacture of bleaching powder. Fortunately the volume of business done by this industry is so great that ample supplies of chlorine are available for the manufacture of explosives in time of war.

8. *Soda.*—The specifications under which practically all of our explosives are manufactured require them when delivered to be free from all trace of the acids used in their manufacture. Usually a small amount of sodium carbonate or bicarbonate is dissolved in one of the washing waters to neutralize any acid that might still be present. The amount of soda required for this purpose, even when our production of explosives was at the maximum during the war was negligible when compared with our monthly production, which averaged more than 300,000,000 pounds.

SUMMARY

In the production of high explosives, as in almost every other branch of war activities, America "made good" in a manner exceeding even the fondest hopes of her friends. At the time of the signing of the armistice our production of military high ex-

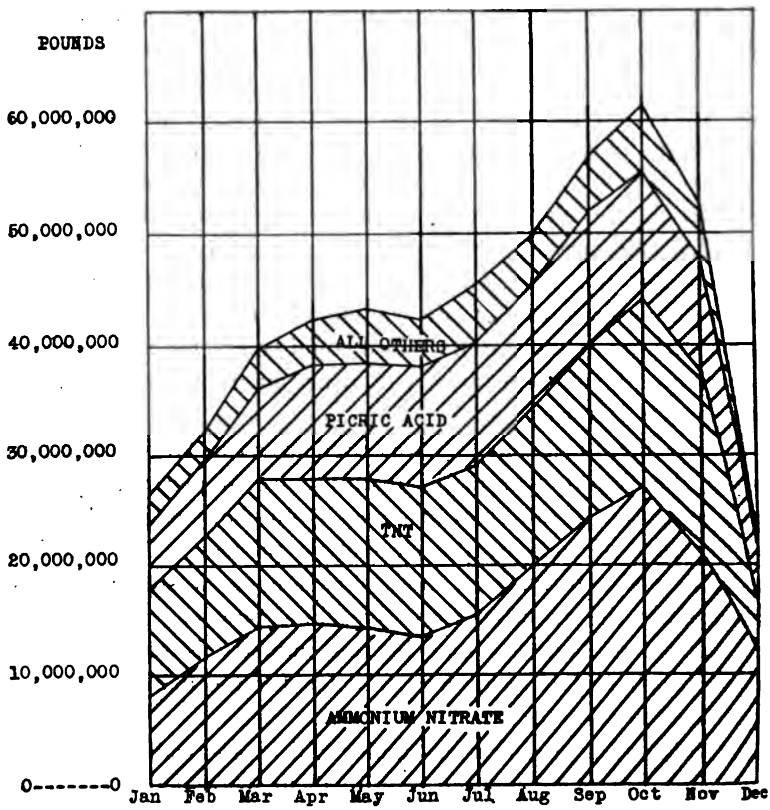


FIG. 14.—Military High Explosives Production, 1918.

plosives was at a rate forty per cent greater than that of Great Britain and almost double that of France. Our total production in 1918 is shown in Fig. 14.

The results achieved after we became a belligerent cannot, however, be taken as representing what we could have accomplished in a similar time with the explosives industry of the

country in a normal condition, for our production of explosives had greatly expanded before we entered the war.

The huge plants which rendered possible our war production of explosives have now largely been dismantled or converted to other uses, so that we would not be able to resume production at the rate possible at the time of the armistice without a considerable interval for preparation. Nevertheless, the development of our resources of raw materials, the perfection of manufacturing processes, and the experience gained in actual quantity production are real national assets which will be invaluable in case of future need.

At the cessation of hostilities our production of high explosives was still increasing rapidly, and there is no cause to doubt that if allowed sufficient time we can produce much larger quantities of military explosives than any other nation in the world.

Our entire production of explosives is, however, dependent upon imports of nitrate from Chili, and hence may be greatly reduced or even brought to a halt by the operations of an active naval force, even though the latter be inferior in strength to our main fleet. This deplorable dependence upon imports for materials required in the manufacture of our explosives can be eliminated by the establishment of plants for the fixation of atmospheric nitrogen, and no efforts should be spared to insure the prompt establishment of this industry in this country.

Every encouragement should also be given our struggling dye industry, both because of the ready adaptation of dye processes and plants to the rapid production of explosives in the event of war, and because the dye industry in time of peace encourages increased production of the materials required in the manafacture of explosives in time of war.

If dye manufacture be encouraged, the use of by-product ovens in the manufacture of coke be increased, and the nitrogen fixation industry be established on a scale corresponding to our natural wealth of the other materials required in explosives manufacture, America need have no fear that, in case of aggression by a foreign power, her army and navy will ever be handicapped by any lack of high explosives.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

RADIO EQUIPMENT ON *NC* SEAPLANES

By Lieut. Commander Robert A. Lavender, U. S. Navy

The prominent part taken by radio apparatus in the trans-Atlantic flight of the *NC* seaplanes has emphasized the uses and needs of such radio apparatus during long flights along the coast and the absolute necessity of efficient apparatus within reasonable limits of weight for the commercial trans-Atlantic air lines which will be organized in the future. It is a curious fact, but yet to be expected, that when the designers and the pilots of air-craft think of radio sets, they invariably think in pounds. Pounds of weight and pounds of head resistance mean pounds of gasoline and oil. And pounds of gasoline and oil mean speed and endurance. But what good would extra pounds of gasoline and oil do if communication and navigation were made uncertain and the lives of the crew and passengers jeopardized when lost during a fog or when drifting on the water with no means of communication? The 26 pounds of radio equipment (emergency transmitter) removed from the *NC-3* at Trepassey Bay, because the plane could not get off the water with full load, should have remained on board for it would have been worth its weight in gold when the *NC-3* came down on the water, a few hours later, 50 miles south of the Azores, with 160 gallons of gasoline, but with no means of communication.

When the radio apparatus was selected for the *NC* seaplanes, the greatest consideration was to carry a minimum of weight and still to have a small factor of safety. A limit of 260 pounds—less than 1 per cent of full load—was allowed for the radio apparatus, although the designers of the seaplanes really expected this amount to be exceeded. The apparatus was to include two complete and separate antenna systems; the radio compass; a

receiver and amplifier; two complete and independent transmitters; and sufficient electrical energy in storage and dry batteries to give continuous operation over the longest leg of the route, and to have four hours of continuous operation on the water with the emergency set.

All this apparatus, except the spark transmitter and the coil of the radio compass, was assembled on a small table (see Fig. 1) located in one corner of the after gasoline and engineer's compartment. The general location is indicated by the *X* in Fig. 2.

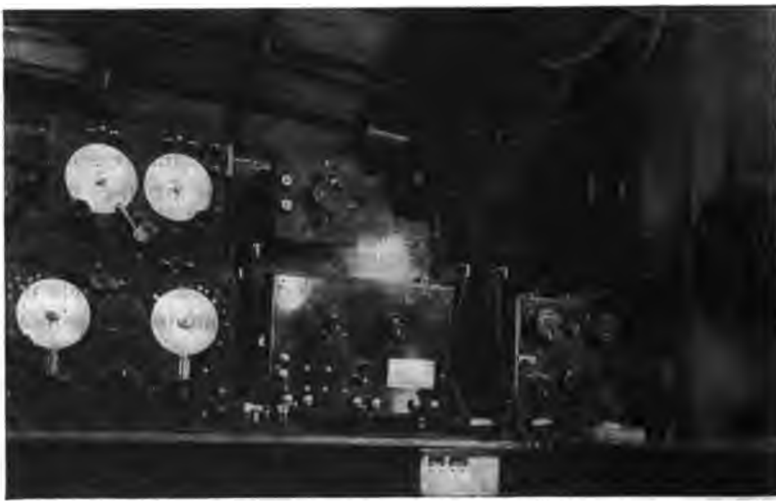


FIG. 1.—Radio Equipment, *NC-3*.

Much to the relief of the designers and the pilots, no accident occurred during any of the tests or final flights due to the sparking of the radio apparatus in the strong gasoline fumes which were always present in the compartment, and almost equally important in the eyes of the designers and the pilots was the fact that the total weight of the radio apparatus was only 250 pounds, 12 per cent less than was allowed and 27 per cent less than had really been expected.

The two antenna systems on the planes consisted of a "trailing" antenna and a "fixed" or "skid-fin" antenna. The trailing wire was 250 feet in length and led out through the hull directly above the radio table, and thence aft to an insulator on

a brace wire, from which point it was suspended. The wire was held in a vertical position by a small, stream-lined, lead weight suspended at the end. When the planes were getting on or off the water, the wire was reeled in on a drum shown at the extreme right of Fig. 1. Connections were made to this wire as it passed through the metal core of the deck insulator. The fixed antenna consisted of a rectangular coil of wire suspended from the skid fins above the upper wing. As the brace wires in and between the wings of wire grounded, the effective range of the fixed antenna was only less than one-quarter of the range of the trailing wire. It was designed for use only when on the water but

FIG. 2.—"Official Photograph, U, S. Naval Air Service."

it served a more important purpose when the trailing wire was ripped off while flying low. Without the fixed antenna we would have been without communication during part of two legs of the flight.

Particularly important in seaplane radio installations is the radio compass. Much has been said and written about the use of the radio compass on board ships and at shore stations where ideal conditions can be realized. There, the location can be selected for its distances away from masses of steel and wires not enclosed in metal conduit. It is to be expected that the radio compass ashore and on ships will work and work well. But on board seaplanes the radio compass has been handicapped, espe-

cially so on board the *NC* type, in which the radio compass was not easily placed or its location freely determined. By force of circumstances and by the necessity of limited space, the radio compass was installed in the only position for it, in the after compartment of the hull, amidships. There it was surrounded not only by the interior electric lighting wires and the brace wires in the hull, but also by the control wires passing back to the tail. These wires shielded and distorted the radio waves as they passed around the compass coils, and caused errors which had to be determined and allowed for. But still more disastrous to the operation of the radio compass was the fact that these wires, being connected to the common ground of the ignition system, formed an antenna to radiate and bring closer the effect of the ignition disturbances, which disturbances are of the same general nature as radio waves and have the same effect as radio waves on the compass coils and apparatus. Nevertheless, with all these difficulties, electrical remedies were applied such that the effect of the ignition system, though not eliminated, was somewhat reduced. Operating the compass revolving control cables with one hand, and the electrical controls with the other hand, listening with both ears to the signals, and watching the pointer over the coils, it required the greatest of concentration on the part of the operator to listen to the signals through the outside disturbances and it required the greatest of care to judge the intensity and thus the direction of the signals.

During the preliminary tests of the radio compass on the *NC-2*, an accurate range of 50 miles was attained but before the flight was taken with the *NC-1*, the *NC-3* and the *NC-4*, the connections of the ignition system were changed to increase the ignition efficiency but which reduced the radio compass range to 15 miles. Unfortunately no opportunity was given, while the resources of a research laboratory were near by, to overcome these disturbances and the flight was attempted with this range. At the Azores the connections of the ignition system on the *NC-4* were again changed but to no advantage to the radio compass. Shortly after leaving the Azores the auxiliary or duplicate spark plug part of the system was put out of commission by burnt out contacts, and as in this part of the ignition system had been located the cause of the greater portion of the ignition disturbances, the radio compass functioned with its former range of 50 miles. It was

providential that this part of the ignition system did fail at this time as the *NC-4* had drifted nearly forty miles off her course due to rough air and an accident to her magnetic compasses, and was practically lost. It was the radio compass which brought the *NC-4* back to the line of destroyers and thence into Lisbon.

Closely allied with the radio compass was the radio receiver. The radio compass itself may be considered a directive receiver, but owing to the small area that it embraces, and because all of its wire was so close to the ignition disturbances, it could not be used for long range reception. Fortunately, the shortcomings of the radio compass as a receiver were not found in the trailing wire, which made an ideal receiver. A notable case in point was a message intercepted while the *NC-4* was in flight approaching the Azores. It came from the U. S. S. *George Washington* 1800 miles away. She was getting into Brest, France, and her radio message which was intercepted was one reserving space on the next morning's train for Paris. This is the record for long range reception by any plane in flight.

The sensitiveness of the radio compass and the receiver and the long ranges obtained with them depended almost entirely upon the amplifier, which was of a six stage vacuum tube type. The amplifier, as will be seen in Fig. 1, was mounted on elastic supports to prevent the vibrations of the hull from affecting it. The amplifier complete was only 12″ x 9″ x 4″ and weighed but 12 pounds. Yet this 12 pounds of apparatus amplified the incoming signals to 50 times the strength they would have been had the best previously known receiver and amplifier been used in its place.

Another interesting feature in the equipment of the *NC* planes was the interior telephone system. This system made it possible for any two persons in the plane to carry on a conversation at any time. A specially improved helmet was developed to hold, directly over the ears, two deep soft rubber ear cups in which were located the head telephone-receivers. The sides of these ear cups were high enough to allow each cup to be fitted to each individual person by cutting it away in places. The helmet itself was received from the factory open at the back and then was fitted to the head of each individual. The microphone, or the part into which one talked, was so constructed that the back of the diaphragm as well as its outward face was exposed to the engine

noises. The effect of the engine noises on the diaphragm was therefore balanced and it failed to respond to any sound waves coming from a distance and only when the lips were placed directly in front of the diaphragm and the sound waves of the voice were thus concentrated on one side, did the diaphragm respond and was speech transmitted. With the sound proof helmets and the special anti-noise microphones, it was not only possible but easy to carry on a conversation, in spite of the 48 cylinders which were roaring continuously only a few feet away. Before the *NC-3* descended near the Azores, the question of landing was fully discussed over the telephone by the two pilots and the navigator. The opportunity of a conference in the air can not be appreciated until after one has been placed in such a position as was the crew of the seaplane, lost in a fog with only a limited supply of gasoline.

The transmitter on which the greater reliance was placed was a ½ kilowatt wind driven spark set mounted on a strut under one of the engines, where it was exposed to the passing air. All the circuits, except the field switch and the variometer, were mounted behind the generator, in the hollow shell required to make the generator "stream-lined" or adapted to air resistance. The spark gap and closed and open oscillating circuits were so arranged that the various leads passed back from one circuit to another until the high tension current, ready for the antenna, was picked off from a clip connection in the tip end of the tail. The complete set weighed but 44 pounds and yet was heard 1200 miles. The two-blade propeller was designed to deliver full power when the seaplane was flying at its slowest flying speed, 65 miles per hour, and as this air speed is approximately the speed of the air behind one of the propellers of an engine when run while the plane was on the water, the same radio set could be used as an emergency set, provided that the engines could be run. But when the *NC-3* landed on the water and the set was thus mounted, the forward motion given to the plane by the pull of the engine caused heavy strains on the already weakened hull, which jumped over and dived into the waves instead of drifting over them. For this reason, grimly as the need was felt, it was considered too dangerous to try to use the set.

The other transmitter, known as the emergency set, is shown mounted on the radio desk. The high voltage required for this

set was obtained from a dynamotor driven by a storage battery, which battery also furnished directly the low voltage current. This little transmitter was capable of radiating .8 of an ampere, which under normal conditions would give a range of 75 miles. The transmitter proper weighed but 8 pounds and with the dynamotor weighed only 26 pounds. It paid for its weight when the *NC-3* landed 40 miles from Halifax. Communication was established with the tender, the U. S. S. *Baltimore,* within 50 seconds. The tender was informed of the location of the plane, the trouble encountered, and the fact that no assistance would be required. This set, because of its 26 pounds of weight, was removed at Trepassey Bay.

Some unit of the radio apparatus above described was in use practically every moment from the time the planes left Rockaway Beach until they reached their several destinations. The radio operator was constantly either sending a message, or listening to the radio compass signals or copying a message from the destroyers. Just as the planes were off Chatham, on Cape Cod, the noon time signal from Washington was received in the planes and the chronometers given another check. Secretary Roosevelt in Washington desired to send a message to one of the planes and to receive a reply. So quickly was the communication carried out that (1) the message was forwarded to a shore radio station, (2) the plane was called and the message delivered to the plane, (3) it was referred to the commanding officer by telephone, (4) the reply was given to the operator, (5) the shore radio station was called and the reply sent to the station, (6) the reply was forwarded to Washington and (7) before *three minutes* had elapsed, Secretary Roosevelt received the reply.

In contrast to this efficient service of the radio equipment was the urgent need of communication by the *NC-3* floundering about in the heavy seas off the Azores, unable to send any message at all because the apparatus designed for such a crisis was left behind on account of its weight. Only the receiving equipment could be used, which told of the plans of search and the "Estimate of the Situation." Later, as we were drifting into port, the apparatus did its final bit: we intercepted—"*NC-3* sighted on water seven miles from breakwater Ponta Delgada under her own power."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

POLICY—ITS RELATION TO WAR AND ITS BEARING UPON PREPARATION FOR WAR

By COMMANDER C. C. GILL, U. S. Navy

Policy, broadly speaking, maps the destiny of a state in the fulfillment of national aspirations as seen and interpreted by those in governmental control.

When national policies conflict, as they continually do and must, diplomacy, backed by potential power, attempts to negotiate a settlement by the medium of official notes and interchanges. These do not always succeed. Then, if the difference is justiciable, susceptible of decision by the application of principles of law and equity, joint appeal may be made to some international court such as that of the Hague; or, if the dispute is purely political and non-justiciable in nature, the nations involved may, by special agreement, resort to a tribunal of arbitration in the hope of arriving at a satisfactory compromise or other suitable arrangement.

But sometimes all attempts at peaceful adjustment fail. Then, if the issue affects the vital interests, the independence, or the honor of the disputants, it has been the experience of history that war usually results and each belligerent strives by force of arms to sustain its avowed policy. Active war is a continuation of policy by violent means.

"UNLIMITED WAR" AND "LIMITED WAR"

It follows that wars are of various kinds according to the policies they are called upon to support. If the object is of great national importance, a matter of self-preservation in which the peoples of the belligerent countries are deeply aroused, and if the two contestants are evenly matched nations or combinations of nations of the first rank, then each side will institute extreme

military measures, the utmost resources of the countries engaged will be under contribution—in such a struggle entire nations are in arms and the course of the civilization of the world may be in the balance. In so far as the chief participants were concerned, the World War of 1914-1918 is an example of this class known as "Unlimited War."

On the other hand, if the matter under dispute is of minor importance, a question relating to a distant possession, an issue toward which the people at large are indifferent, or a contention wherein the parties concerned are of unequal strength, then the objective may not be worth any great military effort, or the weaker belligerent may be incapable of offering significant opposition; in any such case, the point in policy under controversy will be conceded by one side or the other without extensive military operations. Wars of this class may prove of great importance in their ultimate influence on the history of the world, but they are decided without a wide disruption of society or far reaching derangement of the usual pursuits of peace. The Boer War in the Transvaal and the Spanish American War may be cited as familiar examples belonging to this second class called "Limited War."

Policy, therefore, controls the declaration of war, determines its nature and extent and is its master. The statesmen must instruct the strategists as to the political object of the war, and the extent of effort the nation is willing to make to attain it, before the latter can draw plans for its prosecution. In illustration, it is at once seen how the war plans drawn by the strategists of Brazil to govern her participation in the World War were, for political reasons, limited in demanding expenditure of national effort, as compared to the war plans which governed the participation of France.

Policy dictates grand strategy, which, in turn, determines the mutual relations and respective functions of its two branches, maritime strategy and land strategy. The line distinguishing policy from grand strategy is not sharply drawn; to wage war successfully politicians and strategists must meet on common ground and evolve a general plan of campaign to guide and coordinate major operations both ashore and afloat.

THE FUTURE OF WAR

No discussion of policy would be complete without reference to the deep and earnest desire of mankind to safeguard the future against the catastrophe of war. The aspiration for honorable peace is shared by all high minded peoples irrespective of color, race, language, or geographical location, and is much in evidence in modern policy.

With the sufferings entailed by the world conflict fresh in memory, it was to be expected that revulsion to war should find strong expression in the enlightened statesmen gathered around the Peace Table at Versailles. Such was the case and there is nothing new in this. The same sentiment has been evidenced after all the great wars of modern times.

The ideal of world peace dates far back in history and has been recorded in numerous state papers, treaties, and conventions. Now we have the League of Nations, as the most recent manifestation of this world-wide wish to substitute law and order for the violence of war. If there is any immediate prospect of the practical realization of this wish it will have a direct bearing upon policy and especially upon the question of preparation for war.

As a result of Allied victory democratic forms of government are now in the ascendency. This favors the purposes of the League of Nations and if consolidated may well constitute a step toward the establishment of conditions which may eventually bring the ideal of world peace into the field of practical politics.

It is also a gratifying consequence of this war that the sympathies aroused, the community of principles voiced by many peoples, is unmistakable indication of advance toward an approximate unification of mankind. But, in order to reap the full benefit of these advances it is important to understand their limitations and to appreciate that, after all, they are only steps along a road which is sure to be long and difficult.

Danger lies in the beauty of the ideal. This, by influencing reason to capitulate to the bias of sentiment and inclination, may prove a serious menace to the very cause it seeks to promote. "The flower is not hastened in its growth by holding it to the flame." Harm rather than good results from attempts to contravene the slow processes of evolution ordained by nature. The goal of a lasting world peace is one which cannot be reached by

short cuts, and attempts to do so will only result in increased difficulty and delay.

War is a great evil but there are others greater. History has taught that when two policies conflict, moral motives on the one hand avail little against unscrupulous ambition on the other, unless the reasonable contention of the former be backed by adequate physical force. A war which causes good policies to triumph over bad is not an unmixed evil. So used it is preventative and remedial against dangers and diseases which menace the progress of civilization.

Many instances in history may be cited, wherein policy had to decide between just war and dishonorable peace. Of these, three of the 19th century might be mentioned—Crete, Armenia and Cuba. In the cases of Crete and Armenia, war was avoided, but at what a price: the cause of humanity was sacrificed and national consciences surrendered to iniquity. On the other hand, in the case of Cuba, war was preferred, and few people will contend that this just war entailed greater evil than would have been incurred had the United States submitted to the continuance of a dishonorable peace.

But here the objection may be made that these evils greater than war have at last been eliminated, that the overthrow of Hohenzollern ambition marked the final need of war for any such purpose. To this it may be answered that the same thing has been said many times in the past and has always proved an over sanguine and premature assumption. It would hardly be prudent to accept this objection without more convincing demonstration of its truth than is now available, although, as has already been stated, there is encouraging indication that the spread of democratic forms of government may tend to reduce the evils which cause wars of this class. Even after this has been accomplished, however, there still remains another class of wars, the causes of which must also be eliminated before disarmament can safely be proceeded with in the security of world peace.

This type of wars includes those resulting from a clash of policies in which the moral motives of neither one of the belligerents can be fairly impugned. It may happen, and not infrequently has happened, that both sides wish to be guided by moral motives and yet fail in the peaceful settlement of their dispute, because of an honest irreconcilable difference of ethical

opinion. A difference of opinion in which neutral judges might also be equally divided.

This condition will continue until all peoples of the world are influenced by the same moral motives in the same way, and are bound together in a common desire for peace by a natural community of interests. Then all mankind can intermingle and meet for discussion on the same plane or approximately the same plane. It is obvious how far the nations of the world as they now exist, are from this ideal state of reciprocity and agreement.

In illustration of present day divergence, it is well to consider the situation in the Pacific. We have here on one side of this great ocean Asiatics, and on the other side English speaking communities of a quite different race. The former are by far the more numerous in population while the latter in America and Australasia possess an equally disproportionate greater extent of sparsely settled territory.

Racial characteristics and the evolution of history have placed these peoples on different planes of spiritual and social development. The English-speaking communities have evidenced a deep-rooted determination to prevent Japanese and Chinese immigration. The Asiatics object to this and other discriminations against them. Here we have the alleged right of prior possession of property arrayed against the alleged right of equal opportunity for expansion. This is not a new situation in history, and in the past, sometimes the right of possession has prevailed and sometimes the right of expansive growth. The ethical arguments which enter appear to be of such equal balance on the two sides as to render a decision extremely difficult by any principles of law or equity which have so far been established. What persuasion is going to convince intelligent Japanese that it is morally wrong for them to use force to attain what principle and custom indicates to them to be a right? And again, looking at the question from the other angle, what argument can be advanced which is likely to move the inhabitants of California to the admission that their contention of property rights by which they exclude Asiatics is unjust?

Until the barriers which separate nations are broken down, until the relations between Asiatics and Californians are on a parity with the relations between Californians and New En-

glanders—it is clear, when such situations arise as the above, that the policy which will prevail, either in peace or in war, will be the one which is backed by adequate physical force.

Experience and logic indicate that an approximate world unification is a pre-requisite to lasting peace, and that this can only be effected, if it can be effected at all, by a series of wars, the extent and violence of which will depend largely upon the qualities of measuredness and wisdom displayed by those in governmental control in formulating and carrying out the policies of the various states which make up the society of nations. Hence, it is of primary importance that statesmen should study war and its causes, try to lessen its frequency and virulence without impairing its usefulness, and at the same time endeavor to eliminate those evils and resistances which can be overcome only by physical force.

THE BEARING OF POLICY UPON PREPARATION FOR WAR

In due process of time an adequate code of international law and machinery for enforcing it will doubtless be evolved, but, in the meantime, war will have to continue as an instrument of policy. As long as this condition lasts prudence requires that policies be insured by adequate armed force which includes special safeguards such as frontiers protected by mountains, water or other barrier to unlawful aggression, and properly defended lines of communication to outlying possessions.

In a crisis, and in preparation for a crisis, fortunate indeed is the nation whose trustees for the future, those who shoulder the responsibility of governmental control, understand and conform to sound principles in shaping and carrying out an insurance policy of national defense. This is an urgent question affecting the public welfare and the fact that it is intricate and difficult makes attention to it the more important.

Numerous considerations enter and interact on each other in a confusing way. Some of these are of an elusive and unstable nature. Consequently wide diversity of opinion frequently results. The interests involved, moreover, are largely of the future and therefore not brought home to the average citizen whose chief concern is the business of the present. In deciding matters of national defense it is not surprising that prejudice and expediency so often overrule logic, especially under the

shifting statesmanship of democracies. The subject itself, however, is capable of scientific analysis. A satisfactory solution—a matter of growing importance as improved means of communication draw the peoples of the world closer together—is not to be arrived at by evasion or guess work. And it may be added that there is promising evidence that in the future a better informed public opinion will not be so tolerant as in the past of blunders caused by ignorance and stubborn sentimentalism, but will demand that national affairs be managed in an honorable business-like manner. The field is one of cooperation between statesmen and their military advisers.

The particular function of the statesman is to set forth the policies of the nation, indicate how they do or may conflict with the policies of other nations, and distinguish between policies which are vital, and those which are merely desirable. This information having been supplied, the particular function of the military adviser is to point what armed force is required to make these policies prevail either through potential influence in peace or by active use in war. Taking into consideration the resources as well as the aspirations of the nation, the responsible statesmen must then decide what policies shall be insured by the provision of armed force and what policies should be pushed only so far as is possible in peace, with the idea of abandoning them rather than to incur the hazard and expense of war. This is a question of what a nation can do and is willing to do to safeguard its interests.

It is thus seen that the line of demarcation between the province of the statesman and that of his military adviser is fairly well defined. This does not mean that the former should not concern himself with army and navy matters nor does it follow that the latter should remain ignorant of statesmanship. On the contrary, the more each knows of the entire subject the better, and it is essential to cooperation that each should know at least the broad principles which guide the other. At the same time, the line of divided responsibility should be clearly understood and remembered in order that ill-advised trespassing may be avoided. In this connection it may not be superfluous to observe that regardless of whether the government sees fit to provide an army and navy in accord with expert advice or not, it is the duty of those in the military services to make the means that are provided, be

they great or small, as efficient as possible and in active employment as effective as possible.

PRINCIPLES OF POLICY

In making and promoting state policies two considerations enter, one of self-interest and one of ethics. In this respect we find that the fundamental rules of policy governing the relations between nations are not very different from the rules of conduct governing business and social relations between men.

In a community of individuals each man seeks to increase his wealth and to add comfort and pleasure to his own life and to that of his family. Nor do his neighbors question the propriety of this objective so long as the means employed are honorable and do not infringe the rights and privileges of others. It is recognized that the worldly success of a good citizen benefits his community.

It is similar to this in the community of nations. Policies of self-interest, to increase the wealth, power and influence of a state, are the outcome of a natural ambition for progress, and so long as they are furthered by just and honorable means such policies advance the cause of civilization and contribute to the world's welfare. National wealth and power, under control of a good government, commands respect and exerts a beneficent influence in the conduct of world affairs, just as wealth honestly amassed and wisely used by an individual commands respect and works for good in the business affairs of men. It is thus seen that there is a balance between self-interest and altruism. Power of doing good is not helped but hindered by blind idealism which neglects the essentials of self-interest. This applies equally to individual men and to nations. But in this, as in nearly all arguments by analogy, pitfalls will be met if the comparison is pressed too closely. There are marked points of difference between a community of individuals and a community of nations. For one thing, the regulation of intercourse between men has reached a more advanced stage than has the regulation of intercourse between the various states of the world.

In summing up it may be fairly stated that self-interest constitutes the major consideration of state policy, and that it should be frankly accepted as the adequate motive which it most assuredly is. It is a fundamental of human nature, and under the

control of enlightened intellect is worthy and productive of happy consequences. This is not to say that sentiment and idealism have no place in policy. On the contrary they have an important influence on and are closely associated with the more materialistic considerations. In the grouping and regrouping of nations, in the movements of humanity which make up the history of the world it has been shown that the ties of blood and language have a holding power not to be overlooked, that these, however, do not bind as do territorial limits and the forces of physical propinquity, and finally that neither racial ties nor boundary lines, nor do the two together arouse human passions and influence combinations and separations of men as do pressures exerted by economic conditions.

State policy may be said to rest on three principles:

1. *The Principle of Self-Interest.*—Economic considerations count first, territorial second, and racial or ethnological considerations third.

2. *The Principle of Humanity.*—No nation will long endure whose policies violate the moral code of civilization.

3. *The Principle of National Defense.*—A state too weak to defend its policies must be prepared to give way to more ambitious rivals.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HOW THE *CUSHING* TOWED IN THE *MURRAY*

By Lieutenant (J. G.) Paul W. Hains (C. C.), U. S. Navy

Those officers who were stationed at Brest, France, about Thanksgiving, 1918, will recall the episode of the grounding of the *Connor* and the *Murray,* two destroyers who were returning from a "Limey" outing of four days in company with four other destroyers. The *Connor,* senior and therefore at the head of the column, made a rather unusual mistake. It was early in the morning, and the weather was growing thick. She identified Isle Vierge Light for Ouessante; and in turning to port, presumedly to round the latter island, piled well onto the hidden rocks which so infest that part of the rocky French coast. Before the news of the grounding could be flashed to the other craft, the *Murray* had also gone aground and had ripped a huge opening in her bottom about amidships. While the *Connor* (having damaged her shafts and propellers) prepared for the worst, with the wrecking tug *Favorite* standing at full speed up the dangerous Le Four Channel to her rescue, the *Murray* was swung clear of the treacherous rocks by some kind Providence, and started for Brest under her own steam. Very soon, however, this more fortunate of the two vessels realized that she could not maintain even the meagre five knots with which she had started for Brest, and she accordingly signaled for help. The *Cushing,* being the only destroyer within visual distance at that time, made preparations for taking her in tow.

The whole story furnishes most excellent material for wardroom or quarterdeck chats. But it is the purpose of this article to explain how the various problems in seamanship that arose were solved—to tell how the *Cushing* took the *Murray* in tow, how the *Cushing* steered a fair course under adverse circumstances, and

how she eventually transferred the tow-line to a tugboat just outside of Brest Harbor.

The first problem was, of course, to pass a tow-line to the *Murray*—not considered a difficult task generally. On the occasion in question, however, a strong wind and high seas, together with intermittent rain, which rendered lines cranky and unmanageable, combined to make the situation and problem in hand anything but simple. In fact, four different attempts to pass the tow-line, each involving a distinct principle, were made by the *Cushing* before success was attained.

In the first attempt to pass the line the scheme seemed simple enough, it being merely to steam up abreast the *Murray* and drop a line overboard, with a spar or keg attached to the free end. The *Murray* was to pick this up. Accordingly, a good size spar was bent to one end of a five-inch line, and the usual towing gear was laid out on the fantail. The *Cushing* steamed at one-third speed past the *Murray;* the line and spar were heaved overboard, but not until the *Cushing* had almost passed the Murray. The result was inevitable. The line could not be paid out fast enough and the spar was dragged out of the range of the *Murray's* grappling irons.

The second attempt was of similar character but based upon the known fact that a ship will drift in a strong wind faster than a small object in the water, due to the greater wind surface offered by the ship. The maneuvers of the first attempt were repeated with one exception. The *Cushing* steamed slowly past the disabled destroyer in the same direction as that in which she was headed, but to leeward of her this time. The spar was dropped earlier, but still not early enough. When clear of the *Murray,* moreover, the *Cushing* failed to check her speed by backing on both engines; and the net result was as fruitless as before—the spar was dragged far past the *Murray* before that ship could get the line with her grappling irons. Had the *Cushing* dropped the spar some 50 yards astern of the *Murray* and then, when once clear of her, completely stopped her own ahead motion, there is no doubt but that this method would have proved successful. The principle is undeniably excellent. But in its application these two points must be strictly observed or else failure will result: (1) The spar must be dropped far enough astern so that

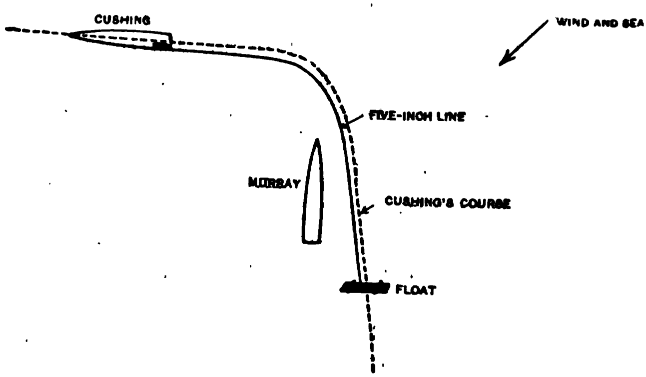
it will not be dragged across a line extending directly to leeward from the disabled ship; and (2) ahead motion on the rescuing vessel must be completely stopped when she is clear of the other craft.

If that line were ever to join the two ships, it became apparent, a little patience, a good deal of judgment, and no little common sense would have to be employed. Why not back down upon the *Murray*, send a heaving line across her bow, and make the five-inch line fast to the end of the heaving line for a third try? It seemed reasonably safe, even with some 1800 pounds of TNT on the *Cushing's* fantail. It was tried. The heaving line shot true, and a sigh of relief went up from all hands—but too soon. Almost at once a great sea lifted the *Cushing* high and sent her hurtling with sickening force against the *Murray's* bow. Full speed ahead was rung up in a vain endeavor to prevent the impact—nay, more than "vain" endeavor, for the very motion of the port screw, which started first, chewed the *Murray's* bow and bent the *Cushing's* port shaft and propeller to such an extent as to render them useless. Slowly, now the ships drifted apart. Even this unfortunate accident would not have prevented success in getting the line aboard the *Murray* had it not been that, in the excitement of the collision, a most major operation was overlooked. The heaving line had not been made fast to the five-inch line on the *Cushing*. The men on the *Murray* hauled frantically on the messenger only to find on the bitter end—nothing. In a few seconds time the *Cushing* had succeeded in losing her port propeller and incidentally a heaving line; and she was no nearer her objective, except perhaps in experience.

The fourth, and successful, attempt was planned carefully and executed with precision. First a heavy float was made to replace the spar which had previously been used. This was accomplished by lashing together several heavy oars and bending them to the free end of a very long five-inch line. The *Cushing* then took up a position well abaft the *Murray*, and when all was in readiness, steamed very slowly past the *Murray* to windward of her. The line and attached float were hove overboard at a point well astern of that ship. Five men were employed to pay out the line as fast as possible. And, now, instead of holding her course, the *Cushing* crossed the bow of the *Murray* close aboard, and when clear of the *Murray* stopped all headway. This resulted in having the

five-inch line lie in a bight about the *Murray's* bow, as illustrated in the accompanying sketch.

By alternately heaving in on the line and then allowing it to sag again the whole line was worked bodily towards the *Murray* slowly but surely. In this operation the large float acted as a sort of sea anchor. Every time men on the *Cushing* hauled in on the line it tended to assume as straight a line as possible between the anchor and the *Cushing,* and in so doing it worked itself closer and closer to the *Murray*. Grappling irons soon made contact with the bight, the line was hauled aboard the *Murray,* and the stout eight-inch towing line was hauled aboard her. It only remained to make everything well secure before the *Cushing*



started ahead very carefully and very slowly with the disabled ship in full tow.

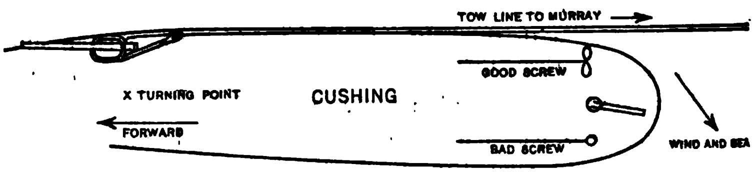
Before proceeding with the problems of steering that arose, it will be well to point out certain conditions, in order to make clear the difficulties encountered. The vessels had to hold a southwesterly course (later a southerly one). Wind and sea were on the starboard bow, and only the *Cushing's* starboard screw could be used. These facts, coupled with the further one that the tow line was led in through the stern chock of the *Cushing* and around the after gun base, made it absolutely impossible to make anything to starboard. Indeed, with helm hard aport it was not possible even to hold the course, much less to make anything to starboard, *i. e.,* to windward. Wind and sea, and the drag of the idle port propeller, combined to make the bow persistently edge off to port. But even stronger was the com-

bination produced by the ahead push of the starboard screw and the tension, due to the towline, on the after gun base. Each of these pulls amounted to several tons, and the arm between them to two or three feet. In this way they made, it will be seen, a powerful couple tending to turn the ship to port. Accordingly, whenever it became imperative to make a more westerly course it was necessary to wear ship completely, and to tow the *Murray* in a long tedious circle back over old tracks to the desired new course, which might be only an exasperating five or six degrees to the westward of the old one. This problem was not satisfactorily solved. Perhaps a dozen times during the 26 hours in which the *Cushing* drove doggedly ahead with the almost waterlogged (if the term may be used with a steel ship) *Murray* in tow, it was necessary to wear ship in this fashion, at the expense of time and exact navigation.

In connection with this difficulty in steering, the writer submits herewith a plan which, though to his knowledge never tried with destroyers, would undoubtedly successfully overcome such a difficulty. It is based upon the towing principle under which the numberless tugs at Liverpool all work. These small but powerful vessels operate in most confined bodies of water, sometimes inside the docks, and they are required to turn sharply and quickly. This is made possible for them to do by bringing the tow line from the large steamer to a point on the tug as near the turning point as possible. The deck fittings and superstructure are so built as to permit of this line's being made fast to a large swivel hook practically amidships. The writer's suggestion for a destroyer in a predicament similar to the *Cushing's* is simply to lead the tow-line forward to the starboard waist gun, taking care to keep the line well outboard and clear of all such things as torpedo tubes, davits, lifelines, and rafts. The advantage lies (1) in removing the anchor effect of the tow line from just above the rudder and placing it forward where it cannot pin the stern down; and (2) in introducing a new force at a point where it would tend to turn the ship in the direction it could not turn with the tow-line secured aft; *i. e.*, in this case to starboard.

Such an arrangement thus puts the good screw and the towing line, the two heaviest forces acting, almost in a straight line fore and aft. Each, accordingly, tends to counterbalance any turning moment introduced into the towing ship by the other; and at the

same time the *stern* of the towing ship is left free to swing a small amount to starboard and as much as is desired to port. With this arrangement a slight degree of right rudder would quickly turn the ship to starboard, while turning to port would be accomplished by slowing down the ship's speed just long enough to allow the wind, acting on the high bow and bridge, to swing the nose in that direction. It will be noted no doubt that the description applies strictly only to a vessel in the exact predicament of the *Cushing,* that is, with wind and sea on the starboard bow and the port screw useless. Other cases would naturally have to be modified to meet the conditions that held; but the same principle of applying the towing line at a point on the towing ship as near the turning point as possible would still be employed to decided advantage.



Projected Plan for Towing the "Murray."

Certain objections to the above scheme may be entertained. And chief among the objections is no doubt the fact that the waist guns on all new destroyers are on gun platforms at a considerable height above the water. Most certainly it would not be advisable to make the tow-line fast to a point so elevated. But the idea is to get the point of application of the towing force as near the ship's turning point as possible, and this should be worked out to suit the individual case. As suggestions, the chart house or the galley might be utilized on new construction, provided very strong stops are used on the line to hold it in a fixed position along the deck, especially where it goes over the ship's side. Needless to say, the tow-line, in any case, would have to be plentifully and judiciously protected from chafing at all sharp edges where friction, however small, might be expected. Few will probably claim as an objection to this departure that the bases of the waist guns on old destroyers are neither sufficiently strong themselves nor firmly enough embedded in the ship's framework to withstand the strain of the tow-line. Experience throughout the late war

with fueling at sea, and an examination of the deck fittings on the gun's bases and the reinforcing beams under the deck, preclude such objection.

The last problem the *Cushing* had to solve was concerned with the transfer of the tow line to the *Dreadnought,* a tugboat sent out to relieve the *Cushing* when the two destroyers were within the entrance to Brest Harbor the morning following the accident at Isle Vierge. It has been recommended as an efficient means of effecting this transfer at sea that the towing vessel bend a small, short line to the main towing line, outboard of the stern chock, and to a good sized cask of any sort that will float. The pelican hook on the towing gear is then slipped, and the cask and line are heaved over the side. The relieving vessel picks up the cask at her leisure. Such a method is all right if the tow line is not large and if the distance to the towed vessel is comparatively great. The disadvantage lies in the fact that a large tow line will not float, and, on the contrary, sinks fairly rapidly. The result is liable to be that the cask is dragged closer and closer to the towed vessel, due to the weight of the bight under water; and the relieving ship is forced to approach the towed ship dangerously close in order to pick up the cask. Again, if the water is shallow the bight of the tow line is in danger of fouling on some object on the bottom. Because of these considerations the above method was not essayed by the *Cushing,* but another one more seamanlike, safer, and involving no cessation of towing, was successfully tried. It was as follows. The *Cushing* held her course, towing the Murray, while the Dreadnough, the relieving tug, steamed abreast of her, close aboard and at the same speed. One end of a five-inch line was led in through the stern chock of the *Cushing* and secured to the eight-inch tow line. The other end was led forward, outboard of everything, to the forecastle, where an ordinary heaving line was bent to it. Men stationed at intervals along the deck held the five-inch line. This having been done, the heaving line was shot across to the tug. Thereupon the tow line was let go by tripping the pelican hook, and the men who held the five-inch line threw it clear. A few minutes sufficed for the *Dreadnought* to slow down and haul aboard successfully the messenger, the five-inch line and the large tow line. The *Cushing* proceeded to Brest.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

REBUILDING THE NAVY'S ENLISTED PERSONNEL AND REESTABLISHING ITS MORALE AND SPIRIT

By Lieut. Commander J. C. Thom, U. S. Navy

The Situation To-Day

The navy is approximately 40,000 men short of authorized enlisted strength.

Enlistments are barely keeping pace with discharges and disenrollments.

Eighty-five per cent of enlistments are for two years.

Reenlistments are so few as to be negligible.

The navy is rapidly losing all of the older, trained, and experienced enlisted men.

Ninety per cent of the present enlisted force are young and inexperienced recruits, possibly good material, but woefully lacking in training, initiative, judgment, and physical development.

More than fifty per cent of commissioned line officers have been commissioned since the declaration of war, either from the Naval Academy, from the ranks, or from civil life, and these officers are generally unfamiliar with prewar conditions, standards, and training methods.

The prewar chief petty officer, the backbone of the enlisted personnel, has vanished. He is either an officer or a civilian.

The present chief petty officer, while representing the best among the present enlisted force, is inferior to his prewar predecessor by reason of lack of experience and training, and is therefore less competent to train recruits.

The Problem

How are we to rebuild the enlisted personnel, reestablish its morale and spirit, and regain the high standard of efficiency which existed in the forecastle prior to the declaration of war?

A SUGGESTED SOLUTION

Any innovation, however logical, is sure to meet with opposition. Naval officers are human, and when once established, they dislike any disturbance of their daily routine. It is not expected that these suggestions will meet with any marked approval from the forecastle, the steerage, the fourth ward, or the heads of departments. However, all hands will admit that something must be done, and the plan proposed herein, though it may never be adopted, may well be of value in causing a certain amount of thought, discussion, and protest, which may result in a better solution for the problem.

In this discussion the suggestions are made with reference to the deck divisions of the larger ships. Certain modifications will be necessary to suit conditions in other branches, and on smaller ships.

It is an acknowledged fact that the older and more valuable enlisted men can be retained in the service only if the present Congress provide for an adequate increase in pay.

Assuming that Congress will increase the pay of enlisted men, we must also assume that the Bureau of Navigation will offer all legal inducements to persuade ex-service men to return to the service. It is to be hoped that many will reenlist; but even the most optimistic among us must admit that a great many, and among them must be numbered some of the most valuable men, will have become established in civil life, with family and business ties which they will not care to break for the rather doubtful advantage of retaining their continuous service status.

At present we can expect that but a small percentage of the total enlisted personnel will be "old timers," men with two or more enlistments in the service. In fact, the great majority of the enlisted force will be recruits. Even those men who have been in for as much as two years are, in a sense, recruits, for conditions in the service since demobilization began have been such as to preclude any thorough training of recruits, and the rapid loss of the older men has deprived the navy of the valuable services of experienced instructors, who were so largely responsible for the efficiency of the prewar enlisted personnel.

It is not intended to infer that the prewar enlisted man received all his training at the hands of his petty officers. All drills and exercises were, of course, directed by officers, and

officers were likewise largely responsible for the efficiency, or the lack of efficiency, of their divisions as a whole, and of such drill units as gun and boat crews. Nevertheless, it is true that by no means all of the training of enlisted men was received during the periods between drill call and retreat. On the contrary the prewar recruit acquired a great part of his more intimate training and the greater portion of his knowledge of practical seamanship, from his association with the older enlisted men, the ship's petty officers. These experienced men were in great measure responsible for the transforming of recruits into sailormen. Their hours of instruction were not confined to drill periods. They taught by precept and example during the hours devoted to ship's work, to drill, and to play. They were the real backbone of the enlisted personnel and their loss cannot be overestimated.

It is obvious, therefore, that a great deal of the training of recruits must devolve upon the officers and particularly upon those who are now watch and division officers and junior officers.

Unfortunately, practically all of these younger officers are as lacking in experience and training as are the present day petty officers. Study the roster of officers of a modern battleship of the fleet. The senior watch officer is a lieutenant of the Naval Academy class of 1916. In prewar days he would be a junior lieutenant of less than one year. Practically all of the remaining watch officers are reserves, temporary regulars, or the product of the wartime three-year dash at the Naval Academy. They have been at sea, as officers, three years or less; have had no experience with prewar methods, standards, or requirements; and have, through no virtue of their own, been hoisted into billets beyond their capacity—which capacity is, except in rare cases, the product of experience and training alone.

No reflection on these officers is intended. They are of the identical breed, and potentially the same, as their older brothers in the service. It is an indisputable fact, however, that an officer with two years' sea experience cannot be expected to handle a division or take a watch as efficiently as an officer with six or eight years at sea.

A good watch and division officer is the product of experience, training, study, and observation. Like wine, he improves with age, and few of the older officers of to-day will say that when they

graduated from the watch officer class they had no more to learn about that important duty.

The average Naval Academy graduate has had practically no experience in handling men; and has but the vaguest conception of his duties and responsibilities. If he is taken fresh from his school books, thrust into an officer's uniform, with two stripes upon the sleeve, and given a watch and a division, the transition is likely to be too swift for his abilities and his character to keep pace. The sudden increase in rank has been known to cause inflation of the ego, and the change from the rôle of midshipman with attendant restrictions, to that of lieutenant with corresponding authority, often results in the overdevelopment of such qualities as arrogance, indolence and "tougeness."

"As the twig is bent so is the tree inclined." Failure on the part of the older officers in the service to correct any wrong tendencies and impressions on the part of the new fledged younger officers may result, at a later day, in injustice to these officers and to the service.

Since we must rely upon officers for much of the training of recruits that was formerly done by experienced petty officers, and since, in general, the division officers of to-day are proportionately as deficient in training and experience as are the present day petty officers, our first step in rebuilding the enlisted personnel must be the inauguration of a rigid system of training for the younger officers.

If we adopt such a system and carry it out conscientiously, we will, while designedly improving the efficiency of our officers, be simultaneously training our men, for the reasons that if, as an item in his own training, a division officer is held responsible for the appearance of his men and their conduct at drill, he will soon take steps to see that they are above reproach. Of course, an officer is now presumably held responsible for any irregularities on the part of his men, when such irregularities are brought to the attention of the proper authorities. In the past, however, heads of departments have not ordinarily called the attention of the executive or of the division officers to minor infractions, it being generally considered that such action savored of officiousness or of tale bearing. It is, therefore, proposed to assign older officers to specific duty as "trouble hunters" who shall be constantly on the watch for irregularities in order that the attention

of younger officers may be called to errors in method and practice. It is proposed that temporarily the heads of departments on board ship be designated as "discipline officers"—for lack of a better name— and that these officers be charged with the responsibility of correcting the faults of the younger officers, training these officers in their professional duties, and particularly in discipline and the art of handling men.

To-day the shortage of men and the inefficiency of enlisted personnel keeps the greater number of battleships tied up at the yards. The prewar exercises and maneuvers are largely abandoned. The time which was formerly devoted to these drills and exercises may now be most properly employed in a period of intensive training of officers and men. And as the younger officers and the enlisted men are to be the victims of this proposed system, it is proper that the older officers devote their time and energies to the task of instructing and training their less experienced shipmates.

To the average naval officer the subject of classes and schoolrooms is abhorrent. Few will accept with alacrity the combined rôle of pedagog, drillmaster, boatsmain's mate, and master-at-arms. With efficiency and morale in the navy at the present low ebb heroic measures are necessary and every officer who desires to see a return to prewar conditions, should be willing to sacrifice a portion of his time and of his comfort to accomplish this result.

Since innovations are unpopular, the plan suggested herein if pursued perfunctorily and as an unpleasant extra duty, will be of little value. It is proposed that the system be made strenuous and exacting at the outset, and that it be given precedence over routine port drills and ship's work. It is proposed that division officers, junior officers, and men be on the job and on the jump from all hands until the end of working hours; that drills and exercises be long enough to be of real benefit but not so long as to become excessively monotonous; and that every drill and every exercise be conducted under the personal supervision of an older officer strictly charged with the duty of correcting errors, enforcing discipline, and requiring on the part of every officer and man concerned, strict attention to the job.

It is proposed that the discipline officers devote their attention chiefly to the officers, but at the same time hold these officers

responsible for the conduct, deportment, bearing, and efficiency of their men. In this way the discipline and training which is forced upon the officers will be communicated by them to their men, which is the ultimate result desired.

As an example of an average day it is suggested that reveille be not later than 5.30 a. m. and that all division officers be required to turn out at this hour and report to their parts of the ship to oversee the work of their divisions. It is further suggested that the discipline officer having the day's duty be on deck during this period for the purpose of supervising the activities of all divisions and of the officer of the day.

Breakfast should be at 7, and at 7.45 all hands should turn to, all division officers being present, to clean up ship for quarters; division officers should muster and inspect their divisions at 8.15 and report them at quarters at 8.30, at which time discipline officers should inspect divisions and part of the ship.

From 8.40 to 9 there should be a brisk physical drill which should be conducted in person by division officers, under supervision of discipline officers, and performed by all officers attached to divisions.

From 9.05 to 10.30 there should be a snappy infantry drill, including physical drill with arms, instruction and drill in the salute with and without arms, etc. This drill should be personally supervised by the discipline officer detailed for this duty, and division officers should never be allowed to take out or send out their divisions for individual drill, except under his supervision. The supervising officer should himself drill the divisions as a battalion, and should in addition, require individual company drill, during which he should correct irregularities in bearing, manner of giving and of executing commands, etc. These drills should be made as snappy as possible. When available a band should be present. It is an accepted fact that nothing improves a man's military appearance, manner, and bearing as much as a thorough course of correctly administered military drill, and for this reason it is proposed to make this drill a daily affair and to lay particular stress upon the necessity for strict attention and proper performance on the part of all concerned.

Retreat from this drill should be sounded at 10.30, followed by a fifteen minute "breathing spell" before battery drill at 10.45. This drill should occupy the period from 10.45 to 11.30

and should be devoted to testing out fire-control and communication systems, followed by a short period of drill for pointers and loading crews.

The afternoon drill period should begin at 1 p. m. and should be devoted to infantry, artillery, or boats under oars or sail. Retreat should be sounded at 2 and from 2.15 to 3 should be held school for officers, at which time lectures should be given by heads of departments to division and junior officers on subjects of professional interest. During this period the men would engage in ship's work or drills under the supervision of division petty officers. At 3.10 should be held school for enlisted men, under the instruction of division officers, and under the supervision of discipline officers. Twice a week this period should be devoted to inspecting bags or bedding, both operations to be under supervision of a discipline officer. Retreat should be sounded at 3.55. Night drills should be held twice weekly, all division officers being present.

The outline above is merely a suggestion and will of course require modification to suit particular conditions on individual ships. It is intended to indicate the amount of daily attention to, and supervision over, the activities of division and junior officers which should be exercised by discipline officers.

All officers who graduated from the Naval Academy in 1917 or later and all officers who have been commissioned from other sources since that date, should be required to keep journals in which should be written each week an article, essay, description, etc., on some subject of interest to the naval service. These journals should be rigidly examined by a discipline officer and marks assigned. Should a journal prove unsatisfactory the owner should be required to submit additional work.

During the period of intensive training, routine ship's drills should be reduced to a minimum. However, particular attention should be paid to the conduct of officers and men at these drills. Instruction in bugle calls and pipes should be given until all officers and men are thoroughly familiar with them, and with the fact that each call for drill, boats' crews, etc., is a signal for some one to step out on the double. This should be strictly enforced with officers and men.

In order to carry out this or a similar plan it is proposed that the heads of departments and other officers, preferably lieutenant

commanders or above, be detailed as discipline officers for the training and instruction of division and junior officers, and to supervise these officers in their work as watch and division officers. These discipline officers should be assigned according to their qualifications, or their duties, somewhat as follows:

Executive: General supervision of all drills and instruction. Responsible for preparation of drill schedule and for assignment of discipline officers.

Navigator: In charge of schools for enlisted men of deck force, and of lectures for officers. In charge of officers' journals and note books.

Engineer: In charge of schools for enlisted men engineer force, and of junior engineer officers' journals and note books. General supervision of drills and inspections of engineer divisions.

Ordnance: In charge of infantry, artillery, and gunnery drills.

First Lieutenant: In charge of emergency drills, physical drill, boat drill.

The executive officer should prepare a comprehensive schedule of drill, instruction, and ship's work, so varied as to reduce monotony, but arranged to cover the entire working day, with fifteen minute "breathing spells" in forenoon and afternoon. He should assign as discipline officers his heads of departments either as outlined above, which outline is based on the duties performed by these officers, or according to the particular abilities or preferences of the officers concerned.

The navigator should have charge of instruction of enlisted men, the actual instruction to be performed by division officers. He should arrange a schedule for approval by the executive, and personally supervise all classes in order to assure himself that this schedule is properly carried out and not in a perfunctory and dilatory manner. This instruction should be confined to purely practical subjects such as seamanship, gunnery, primary navigation, signals, radio telegraphy, naval regs., naval etiquette, customs and traditions, military law, etc. Instruction in academic subjects and specialties should not be included but should be given in special classes upon request.

He should also have charge of the instruction of division and junior officers should arrange for lectures on naval and allied

subjects by officers from his own and other ships, and by civilian specialists when practicable.

He should have charge of officers' journals and note books; should require diligent and conscientious work in these journals, and should, if necessary, assign subjects to be investigated and written upon by officers. He should carefully examine these journals and assign marks, requiring officers whose journal work is unsatisfactory to submit additional work.

At sea, and when practicable in port, he should require officers to perform a reasonable amount of navigation work and should correct all navigation notebooks.

The engineer officer should exercise similar supervisory duties in connection with the school for enlisted men of the engineer force, conducted by the junior engineer officers. He should prepare schedules of instruction and see that these schedules are properly followed. He should, in addition, exercise personal supervision over the drills and inspections of the engineer divisions, and should assign notebook subjects to junior engineer officers, which work he should examine, correct, and mark.

The ordnance officer should have charge of all gunnery, infantry, artillery, and similar drills. If necessary he may be assisted by other officers, such as assistants to heads of departments. He should prepare a schedule of his drills for approval by the executive, and should personally supervise and direct such drills. His paramount duty should be the instruction of division officers in their duties in connection with these drills, and the correction of errors of officers in manner of giving and of executing commands, military bearing, rendering salutes, naval phraseology, attitude toward enlisted men, and toward other officers. The first lieutenant should have charge of all emergency drills, physical drill, and boat drills. His particular interest should be the instruction of officers in the proper stationing and handling of their men, and in the proper deportment of officers and men at drill. He should require all officers to move at the double during emergency drills, and to take part in all physical drills. He should instruct officers in the proper handling of boats under sail and oars, and in the proper method of giving commands for boat evolutions. He should cause to be submitted to him all division watch, quarter, and station bills, and division

books, which he should require to be kept up to date and in approved form.

In addition the discipline officer having the day's duty should supervise bag and bedding inspections, and require division officers to correct all faults.

It should be impressed upon all discipline officers that they are strictly charged with the duty of instructing watch officers in the proper method of standing watch on deck or on the bridge, and that they are required to correct any faults of bearing, deportment, or language on the part of the officer of the day which may come to their attention.

To be of any value this, or any similar system, of intensive training must be relentlessly prosecuted. No errors due to ignorance, indifference, carelessness, or any other cause, should be overlooked. Discipline officers should, from the first, take subordinates to task for all irregularities however slight, of conduct, bearing, manner or giving and executing commands, attitude toward enlisted men and toward other officers, personal appearance, and for all irregularities on the part of their men. Until the present slackness and inefficiency is largely corrected exaggerated disciplinary measures should continue in force until sufficient improvement is visible to warrant gradual modification. Return to normal conditions should depend upon the results obtained and should be a goal for which the chief sufferers, junior officers and men should strive.

In conclusion, the present lack of efficiency and morale can be remedied only by a radical change in training methods. Nothing suggested above is new. Everything has been tried out in the past to a greater or a lesser degree. It is merely proposed to combine various disciplinary and instructional features in one program of intensive training, the primary object being the development of the efficiency of the junior half of the officer personnel; and the ultimate aim the training of the enlisted men, and of the entire service. It is not expected that these suggestions will be adopted, but it is hoped that they may cause some constructive criticism from which a better plan may be evolved.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

LINE OF POSITION BY AZIMUTH OBSERVATIONS

By A. B. Clements

The navigator has from earliest days depended upon measurements of the altitude of heavenly bodies. At first the latitude alone was calculated, then, with the improvement in time-keepers, the longitude also could be obtained. The latitude was for so long a time all that could be determined that it got to have a peculiar value to navigators, and even after it became possible to obtain the longitude, it was supposed to be more dependable than the longitude though the latitude were itself obtained by methods depending upon time, as the reduction to the meridian and single altitude at a given time. In recent editions of Bowditch it is advised that the computed point on the line of position be disregarded in favor of one depending on the dead reckoning latitude, though the computed point is nearer the dead reckoning position than the one recommended and is in a popular sense the "most probable" position. So since the navigator has so long depended upon the measurement of the altitude, he has ignored the possibility of obtaining his position by any other measurement. He has computed his position at sea from a solution of the astronomical triangle using as known quantities the declination obtained from the Nautical Almanac, the altitude, obtained by a measurement with the sextant, and assumed values of either or both the latitude and longitude. The perfection of the circle of reflection and sextant, and the accuracy of observations with them when the horizon is visible, has made this method most satisfactory. The fact that measurements of either of the remain-quantities, if possible, would be equally valuable to him and equally enable him to solve the astronomical triangle and obtain his position is seldom considered, though occasions often arise at

sea where measurement of the altitude with accuracy is impossible and that of the azimuth is practicable and convenient.

There is no way of measuring the position angle of a celestial body, but the corresponding angle of a radio compass station on shore is now furnished by radio compass stations along the coast, and vessels are constantly navigating the coasts of the United States, Great Britain and France, using positions obtained by computation or plotting from these angles. An article on the determination of positions by radio compass azimuths and position angles was published on the back of the Pilot Chart for the North Atlantic for January, 1920, reprints of which may be obtained from the Hydrographic Office, Navy Department.

Little attention has been paid to determining positions by measurement of the azimuth of heavenly bodies, though with the improved forms of the azimuth circle the azimuth may be determined with accuracy. The navigator is often able to see the sun or stars overhead when the horizon is entirely obscured by fog, and many devices have been suggested for determining the horizon or a substitute for the horizon so that sextant altitudes can be measured, and thus the method of solution of the astronomical triangle based on the knowledge of the altitude be used. In such cases it is generally possible to obtain fairly accurate measurements of the azimuth and from a solution of the triangle with the azimuth as a known part obtain points on the line of position more accurately than they could be obtained by computation based on sextant observations of the altitude with uncertain position of the horizon. While the azimuth method is not nearly so accurate as the altitude method, the error of the azimuth method is least when the altitude is great, and as bodies high in altitude are the only ones plainly visible in fog, it is at this time when the usual method fails entirely or is at its worst that the azimuth method is at its best. In the examples given dotted lines are plotted showing the errors in the lines of position due to an error of one degree in the determination of the azimuth.

Since the line of position determined by an observation of the azimuth makes a large angle with the line of position obtained from an altitude of the same body, the two lines may be combined with advantage. As these lines of position are absolutely independent of each other, the position of their intersection is a

legitimate fix, subject only to the errors of the two observations. This method of obtaining a fix may be of great value where for any reason the position of the ship is uncertain and an immediate, even if only approximate, fix is desired.

A convenient method for the computation of points on the line of position by the azimuth method, whether the observed body be a wireless station on shore or a celestial body, is as follows:

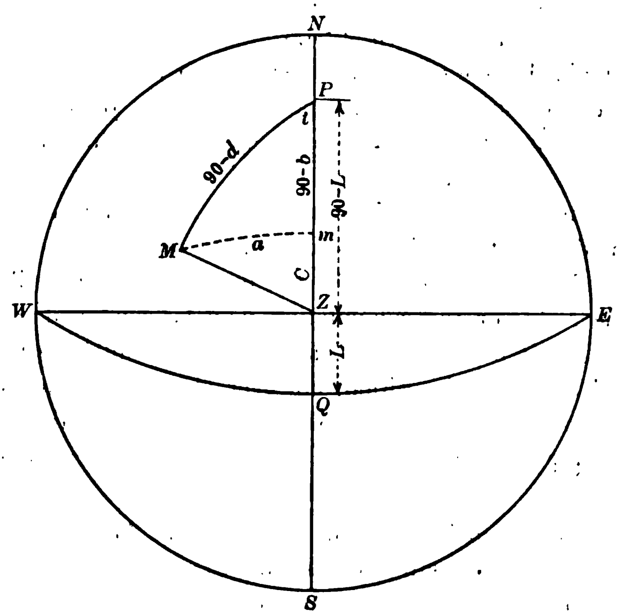


FIG. 1.

Let Fig. 1 be a projection of the celestial sphere on the plane of the horizon.

Z, the zenith of the observer.

P, the elevated pole.

M, the observed body or the zenith of the wireless station on shore.

Mm, the perpendicular from *M* on the meridian of the observer. Then, calling *Mm*, *a*, the length of the perpendicular,

Qm, *b*, the latitude of the foot of the perpendicular,

Zm, C, the zenith distance of the foot of the perpendicular, from Napier's rules.

$$\text{Cos } t = \cot b \tan d, \text{ whence } \tan b = \tan d \sec t; \qquad (1)$$

$$\cos b = \tan a \cot t, \text{ whence } \tan a = \cos b \tan t; \qquad (2)$$

$$\sin C = \cot Z \tan a; \qquad (3)$$

and substituting for tan a from (2) in (3)

$$\sin C = \cot Z \cos b \tan t, \qquad (4)$$

and latitude $= b - C$ when $Z < 90°$.

$= b + C$ when $Z > 90°$.

To obtain the line of position assume two values of t, the hour angle, and compute the corresponding values of the latitude. This line of position can be used as lines of position obtained in other ways are used.

Where measurements of both altitude and azimuth are made and it is desired to obtain a fix, the line of position depending on the altitude may be obtained by the method of Saint Hilaire or the time sight, or the computation may be combined with the foregoing, this being the $\phi'\phi''$ method of Bowditch, 1917, page 134, and this line of position, however obtained, plotted on the chart intersecting the line of position obtained from the azimuth will give the required fix. Or a fix may be computed directly as follows:

$$\sin t \cos d = \sin Z \cos h, \text{ whence } \sin t = \sin Z \cos h \sec d; \qquad (1)$$

$$\cos t = \cot b \tan d, \text{ whence } \tan b = \tan d \sec t; \qquad (2)$$

$$\cos Z = \tan C \tan h, \text{ whence } \cot C = \tan h \sec Z; \qquad (3)$$

and latitude $= b - C$ when $Z < 90°$

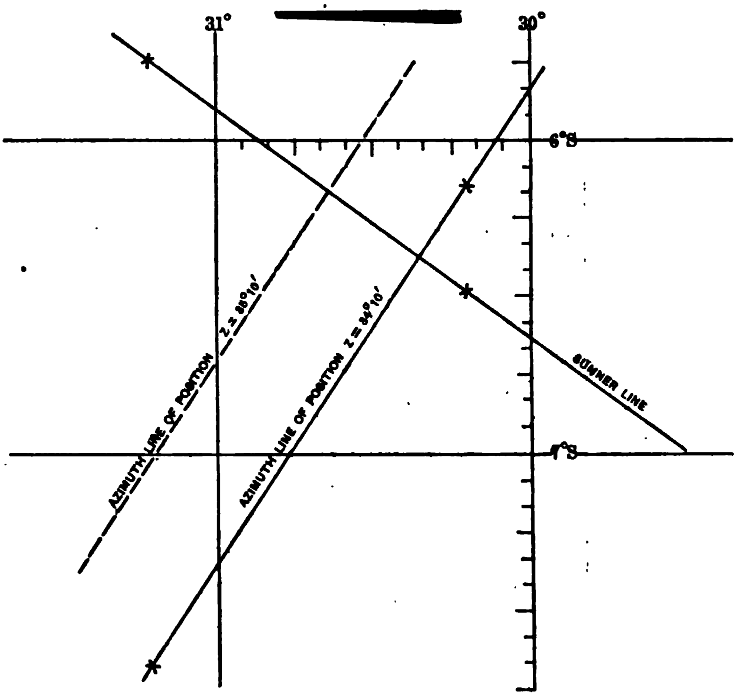
$= b + C$ when $Z > 90°$.

The labor of the computations required in the use of these formulæ as well as in other calculations of navigation involving the solution of a spherical triangle may be avoided by the use of a table of right spherical triangles such as that published by the Navy Department in Hydrographic Office Publication No. 200, Table VI. A larger table that would not necessitate interpolation or corrections is much to be desired. Though such a table would be bulky and contain many pages "It is easier to turn pages than it is to interpolate."

Example 1.—October 10, 1916, 3 p. m., in dead reckoning latitude 6° 21′ S., longitude 30° 21′ 30″ W. At Greenwich mean time 12^h 43^m 32.5^s observed azimuth of moon's center N. 34° 10′ E. and corrected altitude 70° 11′ 03″. The declination is found to be 10° 03′ N. and the Greenwich hour angle 1^h 16^m 51.3^s W. (19° 12′ 49 5″ W.).

Assuming Longitudes 30° 12′ 49.5″ W. and 31° 12′ 49 5″ W.

	Azimuth line of position				ϕ' ϕ'' line of position	
t_1 =11° E.	sec 0.00805	tan 9.28865				
t_2 =12° E.			sec 0.00960	tan 9.32747		
d =10°03 N.	tan 9.24853		tan 9.24853		cos 0.75819	cos 0.75819
z =34°10′		cot 0.16829		cot 0.16820		
h =70°11′03″					sin 9.97349	sin 9.97349
b_1 =10°14′02″	tan 9.25698	cos 9.99304			sin 9.24960	
b_2 =10 16 12			tan 9.25813	cos 9.99299		sin 9.25112
c_{1z} =16 22 08		sin 9.44998				
c_{2z} =17 56 50				sin 9.48875		
c_{1h} =16 42 15					cos 9.98128	
c_{2h} =16 01 15						cos 9.98280
L_{1z}= 6 08 06 S.						
L_{2z}= 7 40 38 S.						
L_{1h}= 6 28 13 S.						
L_{2h}= 5 45 03 S.						



Direct Computation from Observed Altitude and Azimuth

d	=10°03′ N	sec 0.00672	tan 9.24853	
z	=34 10	sin 9.74943		sec 0.08228
h	=70 11 03	cos 9.53019	tan 0.44329	
t	=11°08′53″	sin 9.28634	sec 0.00828	
b	=10 14 22		tan 9.25681	
c	=16 35 51			cot 0.52557
Lat	= 6 21 29 S.			
Long	=30 21 42.5 W.			

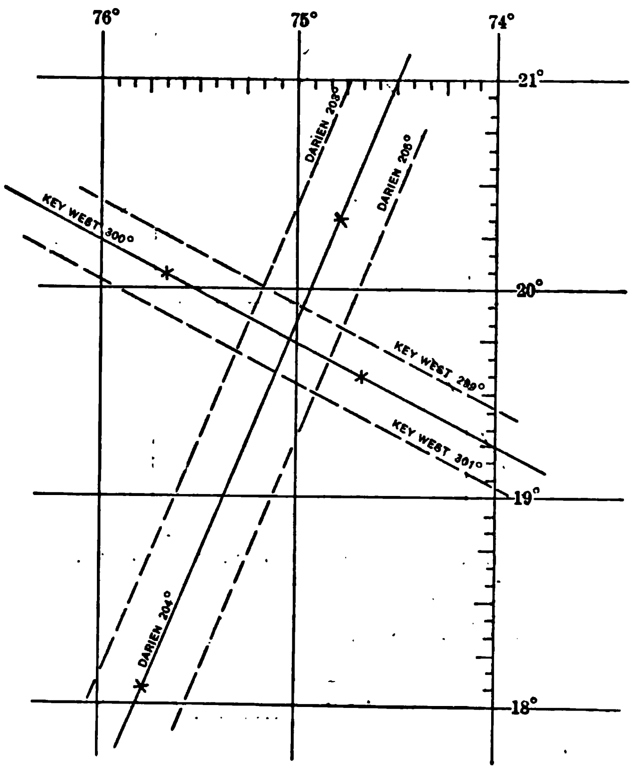
Example 2.—In dead reckoning latitude 19° 31′ N., longitude 75° W. observed radio compass bearings Key West 300° and Darien 204° Position Wireless Station, Key West, latitude 24° 32′ 48″ N., longitude 84° 39′ 52″ W. Position Wireless Station, Darien, latitude 9° 07′ 15″ N., longitude 79° 46′ 20″ W.

FOR KEY WEST LINE ASSUME LONGITUDES 75° 39′ 52″ W AND 74° 39′ 52″ W.

t_1 = 9°	sec 0.00538	tan 9.19971		
t_2 = 10			sec 0.00665	tan 9.24632
d = 24 32′ 48″ N.	tan 9.65964		tan 9.65964	
s = 60		cot 9.76144		cot 9.76144
b_1 = 24 48 58	tan 9.66502	cos 9.95792		
b_2 = 24 52 47			tan 9.66629	cos 9.95770
c_1 = 4 45 40		sin 8.91907		
c_2 = 5 17 57				sin 8.96546
Lat$_1$ = 20 03 18 N.				
Lat$_2$ = 19 34 50 N.				

FOR DARIEN LINE ASSUME LONGITUDES 75° 46′ 20″ W. AND 74° 46′ 20″ W.

t_1 = 4°	sec 0.00106	tan 8.84464		
t_2 = 5			sec 0.00166	tan 8.94195
d = 9 07′ 15″	tan 9.20559		tan 9.30559	
s = 156°		cot 0.35142		cot 0.35142
b_1 = 9° 08 34	tan 9.20665	cos 9.99445		
b_2 = 9 09 18			tan 9.20725	cos 9.99443
c_1 = 8 55 13		sin 9.19051		
c_2 = 11 11 11				sin 9.28780
Lat$_1$ = 18 03 47 N.				
Lat$_2$ = 20 20 39 N.				



U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MYSTERIES OF THE SEA

By James Morris Morgan

In reading the following official report of the captain of the U. S. S. *Victoria,* one of the blockading fleet off Wilmington, N. C., in 1864, it must be remembered that it is dated many years before the mechanical torpedo or the (from) 18- to 40-knot torpedo boat was invented. It is quite a good description of the maneuvers of a Whitehead torpedo or modern torpedo boat might be, but at the time it was written the Confederates did not have a steam launch, such as they used for torpedo boats, which could possibly make over seven knots an hour and the question naturally arises: "What was it that Captain Keyser and the crew on the U. S. S. *Victoria* saw? The Confederates never attempted a torpedo attack at Wilmington as they had no torpedo-boat or launch there.

U. S. S. "Victoria,"[1]
Off Western Bar, North Carolina,
September 9, 1864.

Sir:

.... At 2 a. m. being in four and a half fathoms water, with Bald Head light bearing East half North, and Bug light North East, three quarters North, saw a suspicious looking, very small dim bluish-white water crossing our stern to westward. We soon made it out to belong to something that looked like a large whale, with the water washing over either end of it. I supposed it to be a torpedo-boat, then on our starboard quarter and to westward of us, standing toward us. I started ahead on one bell to bring our starboard broadside gun to bear upon him (the pivot gun cannot be used in broadside) and fired as soon as possible: then started full speed in order to change our position and avoid his blow under cover of the smoke. I then stopped and looked for him

[1] See U. S. Naval War Records, Vol. 10, p. 447.

again. He soon after made his appearance upon our starboard quarter, as before. Not having room to turn my broadside to him, I started, as we headed East South East: full speed to gain room, but he ran parallel to us and as fast as we could go. I then rang one bell, which soon brought him abeam, fired starboard gun again, and went full speed. Having more steam by this time, we easily distanced him and got, as I thought, off shore of him in the smoke and lost sight of him. I then stopped and watched for him. In about fifteen minutes he appeared upon our starboard side, two points forward of the beam. We then started full speed, fired our starboard gun at him, put our helm hard aport, and in the smoke got to westward of him by crossing his stern (I did not expect to strike him before we got around). I stood out in eight fathoms in order to have more room if he tried us again: stopped and set red and blue light at the peak. In about twenty minutes saw him again on port quarter, turned the ship toward him until he was abeam, fired port broadside gun at him. I think and so did all the officers, that the last shot struck him, as he was very near, say forty yards, and the gun was fired with an aim. All the others were pointed with the helm, as he could not be seen from the main deck, it being very dark . . . .

Fired in all five shots: our guns were loaded with shell and grape over them. Wind NNE. very light, and water very smooth.

I am very respectfully
Your obedient servant,
(Signed) E. S. KEYSER,
Acting Master Commanding.

Captain B. F. Sands,
Divisional Officer,
Off Western Bar, N. C.

DISCUSSION

On the Importance of Leadership

(See Page 335, Whole No. 205)

Rear Admiral Caspar F. Goodrich, U. S. Navy.—Owing to my absence in the Far East, the March number of the Institute's Proceedings has but recently come into my hands, hence this belated appreciation of a most admirable article by Captain Knox.

Supplementary to his remarks, which deal chiefly with instruction and study in the matter of leadership, I would like to suggest that something may be done in actual training for command. It is threshing out old straw, I admit, but I cannot lose so good an opportunity as this to deplore the denial to all, except a favored few in each class at the Naval Academy, of exercise in this art. Many graduates hear their voices in giving orders for the first time on going on board a ship. This is regrettable and avoidable. Is it fair? Upon what grounds can it be justified?

The cadet offices at Annapolis should not be permanent. They should be assigned *absolutely by lot* and transfers made once a month, or more or less often as may be necessary to give every man in the first class a trick as commissioned officer in the battalion. Luck alone will then determine whether he occupy for the nonce the exalted position of regimental commander. In this way all suspicion of favoritism will be eliminated and every member of the graduating class will make his own record in displaying officer-like qualities to which a proper multiple ought be given in fixing his final order of merit. The Academy teaches everything needed except this one thing, how to lead men. One would suppose it more important to young officers than any technical branch.

That the battalion's drills would suffer by not having permanent cadet officers is a mere supposition, a begging of the question. Personally I believe there is no chance whatever for such an outcome and I base my belief upon facts and experience, not upon theory. The plan suggested I tried in the Princeton Naval Unit. It worked to perfection and, in addition, every man in the unit was convinced that I had no favorites; that all stood on the same level and had equal opportunities for giving orders and seeing that they were obeyed. It is impossible to exaggerate the keenness with which these young men fitted themselves for their new duties as cadet officers or the thoroughness with which they lent all their energies, even when demoted, to maintaining the morale and smartness of drills of the corps. Under such a practice there could be and there was no dissatisfaction. Disappointment? Yes, but for that no one was to blame. The fickle goddess, Chance, alone was answerable.

U. S. NAVAL INSTITUTE

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ANNAPOLIS, MD., September 15, 1920.

INFORMATION INDEX

PROFESSIONAL NOTES

PREPARED BY

LIEUT. COMMANDER H. W. UNDERWOOD, U. S. Navy

GENERAL ARRANGEMENT

FRANCE

French Naval Progress.—The voting of the Marine Budget by the two Chambers has shown that the Senate is at one with the Chamber in urging the prompt taking in hand of an enlarged shipbuilding and aerial program worthy of France's past traditions and present responsibilities. Senator Berenger called attention to the growing competition of naval armaments that were themselves the expression of economic rivalry, and hinted at possibilities of the near future which France could not afford to ignore. Whilst having neither the wish nor the means of competing with her great allies, France owes it to herself as well as to her friends to remain a determining factor at sea and to make the most of her unique strategic assets for the defence of her vital interests. She must ever remember that the million troops she could raise in her colonies and the unlimited supplies she could draw from the same sources—and that would be vital assets against Germany—would be of no account whatever, but rather a ransom in the hands of her enemies, without the support of an adequate fleet at all times in a position to maintain safe communications by sea. Therefore the absolute naval command of the Western Mediterranean, together with the undeferred organization of a reliable trans-Mediterranean flying service, must be the basis of the French naval policy, which means—remembering the *Goeben-Breslau* affair—that the Republic cannot safely allow any continental power to eclipse her in the matter of speed and calibers. With these views, that were supported by the unanimity of the Senate, Minister Landry concurred, and announced that the 1921 Budget now under preparation would mark a first and vigorous step towards the expansion of the navy, and provide for super-scouts and aerial cruisers of bombardment.

Contracts are being awarded for six torpilleurs of under 1000 tons, to carry 4-inch guns and 22-inch torpedoes, intended for general duties off the coasts and with the fleet, as well as for six 2000-ton conducteurs d'escadrilles of 36 knots to mount 5.5-inch weapons, designed for high sea work with the cruiser divisions. The " fragilité excessive " of the destroyers of 800 tons, that has been denounced in the Chamber, is this time to be

avoided, the war having brought home to French naval men the value of robustness and of reliable sea speed. Similarly the new submersibles, made with the cooperation of private constructors, are to be freed from the notorious defects of the *Lagrange* type and to have reliability as their strong points.

The foresight of the British Admiralty in providing for an ample reserve of oil fuel for British ships is much admired and envied on this side, where governmental instability and traditional incompetence at the head do not permit the application of the old precept: *Gouverner c'est prévoir.* Oil fuel in adequate quantity has become the primary condition of sea and air power, and for the present at least France is badly handicapped in this respect, though bright hopes are entertained for the future. Under recent arrangements France is to receive 25 per cent of the production of the Mossul oilfields and of the Anglo-Persian Oil Co., but this source of supply is subordinated to the Franco-British alliance, and Gallic experts would like to be independent. Hence the efforts being made to develop the petroleum wealth of North Africa. The three zones of Algerian wells yield some 30 tons of oil per day, the rate of supply being relatively higher than is the case with either Rumanian and American wells. Preparations for the opening of petroleum wells are being made in Tunisia and Morocco, whilst Franco-British concerns are already tackling the problem of petroleum exploitation in Madagascar and Indo-China, where exist abundant oilfields. France is now suffering so very much from shortage of fuel that the administrative red tape that is peculiar to our Republican régime is not this time to be allowed to delay progress, and in a very few years there is a probability of our Republic being in possession of a fully-adequate oil supply of her own, a *fait nouveau* that will have far-reaching consequences in fighting efficiency and all-round maritime expansion. The unpalatable result of the actual fuel shortage may be gauged from the lamentations of a *vieil amiral* in a recent number of the *Moniteur de la Flotte*. French battleships are keeping to harbor for the sake of economy; *erreur fatale, conséquences incalculables,* jubilation among Toulon publicans and spirit dealers, but indignation and disgust on the part of thoughtful Frenchmen. The 24,000-ton Courbets are reproached with consuming one ton of coal per mile—*de l'argent en fumée,* as used to say the late Mons. Pelletan—but a *flotte immobile et stagnante* is nothing more than expensive make-believe that deceives no one. British squadrons, it is noted, are keeping in splendid trim, ever at sea, with motors and armament in perfect working condition; and even Italy, despite her slender resources, is straining every nerve to make her dreadnoughts and flotillas something more than a naval pretence. In truth, the situation is not quite so bad as depicted; new life is gradually being instilled into the flotillas that comprise newly-refitted destroyers and submarines, and the *Charlier* battleships are to test at sea their recent motor and ballistic improvements in combined maneuvers with the *Toulon* and *Bizerta* flotillas.

Investigations made by the Commission de la Marine point to a deterioration of the quality of the navy personnel as the consequence of injudicious recruiting and of disastrous blunders by the Leygues Administration. The seafaring Bretons, who formerly composed the bulk of the fleet and were a tried element of fighting strength, have been mostly replaced in the course of the last three years by 46,000 short-term volunteers (*engagés volontaires*), of whom it has been officially stated that 50 per cent remain *invinciblement refractaires à toute éducation maritime.* Happily this rabble in naval uniform that caused the Black Sea rebellion is to be completely cleared out of the service by the end of 1921, when the Gallic Navy will become anew a service of true seamen, fully alive to the grandeur of the maritime career and inferior to none in professional worth. The physical standard especially will be higher than at any previous time, as the result of the patriotic efforts of Minister Landry, who from the first grasped this capital fact, long realized in England, but ignored by his predecessors, that bodily

health and strength is the true foundation of fighting efficiency. Gold lace on blue sleeves does not make officers, that is, military leaders, but only the love of manly efforts, both physical and mental, since victory in war requires a full display of the noblest qualities, together with constant watchfulness and cheerful readiness to face any odds.

Such are the new ideas being inculcated in the *élèves de l'Ecole Navale* and naval cadets who last week landed at Lorient from the destroyer *Aventurier* (1000 tons, 30 knots), aviso *Meuse* (850 tons), and cruiser *Jeanne d'Arc* (11,000 tons, 21 knots) to witness at the *Ecole de gymnastique* a display of the novel methods of physical culture and to receive the explanations and commendations of Lieutenant Bonneau, who is continuing the remarkable work of Lieutenant Hébert in the physical training line. Henceforth, from *apprenti-marin* to admiral, the first duty of the Gallic seaman is, in the words of Herbert Spencer, to be a "fine animal," and, indeed, when past traditions are considered, it is not exaggerating to say that a new era is opening in French naval annals, due in a great part to British influence.

Whereas the physical standard of French naval officers was formerly rather low, owing to the absence of physical tests at the Ecole Navale, it is interesting to note that 10 per cent of the 1920 candidates have been rejected as being inferior to the required standard, though they had successfully passed through the competitive examination. This means something of a revolution. *Navale* is no longer to be the refuge of weedy youngsters unfit for St. Cyr. Under the new conditions greater physical endurance is required from naval officers than from army officers, and it is no secret that the war has seen occasional failings on the part of physically inefficient unit and group commanders.—*The Naval and Military Record,* August 4, 1920.

FRENCH SHIPBUILDING OUTLOOK.—In its economic survey of certain countries specially affected by the war at the close of the year 1919, the British Department of Overseas Trade has this to say of France's shipbuilding prospects:

"The merchant navy of France before the war numbered 1895 steamships and 15,824 sailing vessels with a gross tonnage of 2,535,775 tons. These vessels were manned by 98,730 men. Construction had proceeded, but slowly during the years previous to the outbreak of hostilities and the inferiority of France in comparison with the great trading nations had become more marked.

"In the years 1912, 1913 and 1914 she purchased in foreign countries 156 steamships and 18 sailing vessels with a tonnage of 211,757 tons. Yet even with this assistance she was outstripped by other countries. A detail of some interest is that the average tonnage of steamers constructed in France in the three years mentioned was 3040, 3410 and 4260 tons respectively, while that of the steamers purchased abroad was only 1560, 1030 and 1780. The result of the slow increase of French construction was that France became increasingly dependent on foreign bottoms, and that a large toll in freight had thus to be paid for the service rendered, which has been estimated at 500,000,000 francs.

"The situation has not improved. It is estimated that during the period of hostilities 961,621 tons were lost by enemy action, and 136,887 tons by the ordinary accidents of navigation. Shipping under the French flag was thus reduced to 1,457,267 tons. To replace these losses 227,000 tons are now building. An estimate of future construction which has been prepared by the competent department gives the following figures:

Year	No. of vessels	Gross tons
1920	159	605,665
1921	172	704,361
1922	176	765,377
1923	183	793,405

"A difficulty, which is a grave obstacle to the construction of merchant ships in France, is the high cost of raw material and in this respect the situation has become more difficult on account of the depreciation of the franc."—*The Nautical Gazette,* August 14, 1920.

GERMANY

"DEUTSCHLAND ZUR SEE."—Whilst the execution of the peace terms has deprived Germany of her most effective naval material, it is incorrect to assume that the German Fleet has entirely disappeared. A new fleet has already been formed, within the limits prescribed by the Treaty. The collection of vessels recently placed in commission is officially termed the *Reichs-Flotte,* but is sometimes referred to as the *Verteidigungs-Flotte,* or Defence Fleet. It may be recalled that the avowed object of the naval clauses of the Peace Treaty was to reduce German naval strength to the requirements of police and frontier control. The post-war fleet was therefore to contain no more than six battleships of the *Deutschland-Braunschweig* type, six light cruisers, 12 destroyers, and 12 torpedo-boats. With regard to the renewal of floating material, it was laid down that new vessels built should not exceed 10,000 tons for armored ships, 6000 tons for light cruisers, 800 tons for destroyers, and 200 tons for torpedo-boats, and unless ships were lost no *Ersatz* battleship or cruiser was to be built until the vessel it replaced was 20 years old, or, in the case of destroyers and torpedo-boats, 15 years old from the date of launch. The building or acquisition of submersible craft of any description was absolutely inhibited. The maximum strength of the personnel was fixed at 15,000, including officers and the staff ashore, and of this total not more than 1500 were to be officers and warrant officers.

Until quite lately it was widely supposed that Germany would not go to the trouble and expense of maintaining a properly-organized naval force, which, consisting only of out-of-date vessels, would have practically no defensive value. This expectation, however, has not been fulfilled. The latest news from Berlin shows that the full naval establishment authorized by the Treaty is now in being. There is some doubt as to the present condition of the six old battleships which have been commissioned. Most of them had been partially dismantled before the end of the war, their guns being taken for work at the front, and certain fittings and structural parts removed to be embodied in new submarines. Probably, however, all the six have since been refitted and rearmed. The oldest ship in the group is the *Braunschweig,* which was launched in December, 1902, and the youngest is the *Schlesien,* launched in May, 1906. Consequently in little more than two years from now Germany will be at liberty to lay down an *Ersatz* armored ship for the *Braunschweig,* and by 1926 she may be constructing new vessels in place of the entire six—always provided that the substitutes do not exceed 10,000 tons in displacement.

The six light cruisers of the post-war fleet are older even than the battleships, selected as they are from the best ships among the *Gazelle, Frauenlob,* and *Bremen* classes, dating from 1899-1905. As the oldest light cruiser, the *Amazone,* was launched in 1900, Germany will be free to lay down an *Ersatz* this year if she so desires; and whereas the *Amazone* is of 2,650 tons only, her successor may be anything up to a limit of 6000 tons, which is quite a substantial displacement for light cruisers. There would be no difficulty in building a cruiser of this size capable of steaming at 30 knots, with an extensive radius of action and a powerful armament. The 24 destroyers and torpedo-boats are mostly obsolete, but a few boats built in 1912-13 are included, these being about 600 tons, with an original speed of 32½ knots, and an armament of two 3.4-inch Q. F. and four 19.7-inch tubes. Some of the torpedo-boats now in commission are already eligible for replacement under the 15-year age proviso.

The following is a complete list of the vessels of the German *Reichsflotte* now in commission:

Battleships: *Schlesien, Schleswig-Holstein, Hannover, Hessen, Elsass, Braunschweig.*

Light cruisers: *Berlin, Hamburg, Arkona, Medusa, Amazone, Thetis.*

Destroyers: *G-8, G-10, G-11, S-18, S-19, V-2, V-3, V-5, V-6, T-185, T-190, T-196.*

Torpedo-boats: No. *99, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 113.*

It will be seen that the German Fleet as at present constituted, is really a coast-defence force, more to be compared with the navies of the minor European states than with those of the great powers. But it is large enough to be used for training purposes, and this no doubt was the German Government's principle motive for organizing a post-war fleet at all. Wilhelmshaven, it appears, is to remain the chief naval base, in spite of the "demoralizing atmosphere" which Admiral Hollweg declares to have prevailed there since the revolution. Apart from its obsolete material, the German Fleet of to-day is sorely handicapped by a shortage of efficient officers. According to Admiral Hollweg practically all the officers who remained with the fleet after the great collapse have since resigned, owing to their inability to preserve discipline. The seamen are said to have become incredibly lazy and insolent, and the ships and establishments at Wilhelmshaven are run more or less on Soviet lines. So long as affairs remain in this condition the service will offer no attraction whatever to officers of a desirable type. It remains to be seen whether the drastic measures which have kept the *Reichswehr* free from Bolshevist contamination will eventually be applied to the navy as well.

Enormous harm was done by the late Minister of Marine, Admiral von Trotha, an officer of the highest professional attainments, but an uncompromising reactionary in politics. There is no doubt that he attempted to use the fleet as an instrument for the furtherance of Monarchist aims. This was bitterly resented by the seamen, and when, at the time of the Kapp affair, he pledged the navy's allegiance to the usurping faction, there was a general mutiny at the naval ports. Von Trotha's conduct bears out the oft-repeated statement that politics was one of the root causes of the German Navy's collapse. Further confirmation has just been supplied by Grand Admiral von Tirpitz, whose dissertation on the state of Europe, published in *The Times* last week, reveals him in his true guise as a zealous, but woefully misinformed politician. Had von Tirpitz set an example to his subordinates by studying Mahan and Colomb, instead of saturating himself with the Pan-German doctrines preached by Treitschke and Schiemann, the German Navy might have proved less of a dismal fiasco in the late war. If von Tirpitz's appreciation of *Weltpolitik* gives the measure of his acumen in other matters, we need marvel no longer at the shipwreck of German naval policy.—*The Naval and Military Record*, August 11, 1920.

SHIPBUILDING IN GERMANY.—The extent to which the construction of new ships is being carried on in Germany at the present time is probably not known outside the initiated circles of that country. The returns concerning the situation of the world's shipbuilding industry at the end of June in the current year were accompanied by the statement that the figures for Germany were not yet available. It is known, however, on the one hand, that the shipyards have been occupied for many months past with the completion of ships already in hand at the date of the Armistice, the repair of other vessels, and the finishing of floating docks for surrender to the Allies under the Treaty of Peace. Two of the docks of large dimensions are said to have been sold by, or with the consent of, the Reparation Commission, and to have been delivered to Holland and Norway respectively in the past few weeks. But it is known that ships were in progress in the German yards during the same period for the account of the Reparation Commission, and also for delivery to neutral countries. Indeed, it is claimed

that although many contracts for neutral nations are still on hand, orders for neutral account similar to those which were extraordinarily remunerative a few months ago are no longer expected, as, owing to the inflated prices for iron and steel, the costs of construction have risen to the level of, even if they are not higher than, the prices prevailing in the world's markets. If the assertions respecting orders for work for other than Allied account are well founded they may possibly refer to small ships of 1000 gross tons and less, but if the reports be true that much larger vessels have been or are being completed, it is impossible to avoid the impression that the Reparation Commission is in no hurry to exact the delivery of the particular amount of tonnage set forth in the Treaty. The Treaty provides that within three months from its coming into operation the Reparation Commission shall notify to the German Government the amount of tonnage to be laid down in each of the two years next succeeding the three months in question. No doubt such a notification was given, but the exact tonnage concerned has not yet been stated. A similar notification is to be given two years after the Treaty came into operation with regard to the three following years, and the amount of the tonnage to be laid down is specified as not to exceed 200,000 tons gross per annum.

The opinion prevails in certain circles in Germany that the Allies will not incessantly demand the delivery of the ships provided for under the Treaty of Peace. This optimism is based, not upon any question of change of opinion on the part of the Allies, but solely upon the assumption that the reaction taking place in freights is causing, or has already caused a decline in the number of new orders received for ships both in Great Britain and the United States, and that with less work in prospect in the future Allied shipbuilders would not look on quietly while the German yards were busy on the production of ships for the Allies. We reproduce this view of the problem for what it is worth. At the same time there is no doubt that the German yards are constructing, and are being permitted to construct, ships other than those for the Allied account, consistently with the quantities of raw materials available. This view is supported by the fact that the shipowners and shipbuilders are demanding the delivery of twice as much shipbuilding material as they received in pre-war times, and are making representations to the Ministry for Economic Affairs, complaining that the steel makers are exporting three times the monthly tonnage of ships plates, etc., supplied to the national shipyards—a complaint which the iron and steel interests affirm is without foundation, 8000 tons monthly being delivered in each case. It is not easy to reconcile zeal of this character with work for Allied account and at prices per ton to be determined and accounted for by the Reparation Commission. It thus seems as if some relaxation of the conditions relating to the delivery of ships has already been made. As bearing on this matter, the following passage may be quoted from a German newspaper: "If we were entirely free in shipbuilding, and if we had sufficient constructional materials and a body of workmen again glad to work efficiently, it would probably be possible for our shipowners, with the large-hearted assistance of the Reich, within a few years to fill up in some measure their stock of ships by means of new construction in our own country." The total production of the shipyards in Germany, in 1913, amounted to 510,000 gross tons, including warships, and included 34,000 tons for foreign account. It is calculated that with the new shipyards built during the war or approaching completion, and the extensions now in progress, the productive capacity of the country has been advanced or will soon be increased to 1,000,000 tons per annum. But there is a vast difference between output capacity and actual output, and a long time will necessarily elapse before the production reaches the level of that which prevailed in 1913 unless a very substantial improvement takes place in the supplies of raw materials to the iron and steel works, and consequently of semi-finished and finished materials and of machinery for the shipyards. The country has adequate coal resources, but it is desired to keep deliveries for home consumption; the pro-

duction of pit coal was 10,000,000 tons greater in the first half of this year than in the corresponding half of 1919. In the case of iron ore there has been a considerable increase in the imports from Sweden this year. Iron ore resources have been obtained in Brazil; and German emissaries scoured Spain, South America and the Dutch Indies during the war in order to secure ore concessions, and have succeeded in some cases, while hopes are entertained of again receiving ore from South Russia at no distant date. Of course, most of these problems relate to possible future developments, thus showing the foresight exercised by the iron and steel interests during the years of hostilities.

For the present, German hopes are concentrated on the possibility of reconstructing the merchant fleets. Builders have been complaining that they are hampered not only by the scarcity of shipbuilding materials, but also by the high prices charged for them. They, however, now have the satisfaction of knowing that the price reduction of two months ago was followed by a further decrease last week, so that the costs of construction should further decline. The policy of steel makers taking up financial interests in shipyards, which was begun before and continued during the war, is now being extended so that the yards are gradually becoming assured of constant deliveries of plates, sections, etc. But the limits imposed by the iron ore problem upon the production of these materials will retard the revival of the shipbuilding industry on a large scale for some years.—*The Engineer*, Aug. 6, 1920.

GREAT BRITAIN

IRELAND IN WAR TIME.—In view of our leading article a few weeks ago on the strategical aspect of the Irish problem it is interesting to note that Mr. Lloyd George has just told a Labor delegation that the granting of complete independence to Ireland would not be compatible with the security of British communications. He referred to the very large number of ships sunk by German U-boats off the Irish coast, and developed the point, raised in our article, that if during the war the Irish coast had been in hostile possession we could scarcely have hoped to overcome the submarine menace. It is reassuring to find that the government is not unmindful of this highly-important aspect of the Irish question, to which far too little attention has hitherto been paid. Fairness compels us to add that service opinion is not unanimous as to the influence that Irish independence would have on a future war in which Great Britain was involved. We remember a prize essay published in *The United Service Magazine* some eight years ago on the subject of what changes would take place in the existing stretegical position of this country owing to a maritime war (1) if Ireland were neutral; (2) if that country were hostile. The writer denied that an enemy who proposed to invade England would gain any advantage by first landing troops and stores in Ireland. As regards the trade routes, he concluded that Irish hostility would not affect naval strategy, for Ireland had no navy. It would, however, facilitate the seizure and occupation of a suitable base. His summary of the whole matter was as follows: Ireland, possessing neither an army nor navy, could not enforce neutrality, and therefore her pretensions to neutrality would be wholly ineffectual. Ireland's hostility would react upon the military rather than the naval situation. It would not alter very much the distribution of the fleet, for that depends mainly on the whereabouts of the enemy's fleet, and an enemy would be unlikely to send his fleet into Irish waters which are in the area of Great Britain's maximum control where our fleet could wage war most successfully. This, of course, was written before the day of the long-distance submarine and its application to commerce-destroying work. In the essayist's opinion, Irish independence had another aspect in its relationship to war: "War is a reality, and its reality lies in this—that it requires a principle and practice of government entirely different from the piping times of peace. Ireland's

economic existence is based on Great Britain. Her commerce and her shores are protected by our fleet, but the pillars of her national life are lost to view in the froth and spume of Hibernian provincialism. Ireland can only approach others by sea, and her real independence can only rest on British supremacy at sea. Ireland, so far as the sea is concerned, must remain one with Great Britain."—*The Naval and Military Record*, August 4, 1920.

NAVAL RESEARCH AND EXPERIMENT.—In nearly every proposal that we have seen with regard to the broad principles which should govern British naval policy in the years ahead great emphasis is rightly laid on the necessity of devoting a generous percentage of available funds to reasearch and experimental work. The Admiralty have given a definite assurance that everything possible will be done in future to keep the navy abreast of scientific and technical progress. A Department of Scientific Research and Experiment has been created under the Controller of the Navy, and steps are being taken to extend the facilities enjoyed by the service for working out problems in connection with the development of every description of naval material. For instance, experimental establishments have been attached to the technical training schools at Portsmouth, and it is well known that they have already performed a great deal of useful work in improving mines, torpedoes, and electrical apparatus. Another branch which the war brought into existence is the Anti-Submarine School, an institution of capital importance which ought on no account to be handicapped by lack of funds. The Admiralty's general scheme for promoting research looks satisfactory enough on paper, but we know from experience that these excellent projects have a way of getting quietly shelved in the course of time unless the searchlight of publicity is trained upon them at regular intervals. Next to the welfare and contentment of the personnel, we consider an unremitting study and application of war experience to tactics and material to be the most important present-day duty of the naval administration.

It would be absurd to pretend that the weapons and material we possessed at the outbreak of war were as perfect as they might have been. The German torpedoes, mines, and projectiles were superior to ours, and it is no use denying that the efforts of our commanders at sea were often stultified by the indifferent material they had to work with. Apparently there had been too much theory and too little experiment. It seems almost incredible that the deficiencies of our armor-piercing shell—to mention one notorious example—were not discovered until the day of battle. The suggestion that the projectiles were the best that could be manufactured at that period is preposterous; moreover, it is disproved by the fact that as soon as the failure became known we at once set about producing shell of infinitely better quality, although the enemy never gave us an opportunity to test them upon his ships. In this case no doubt departmental conservatism was at the root of the trouble, but a contributory cause was the short-sighted policy that refused to spend money on practical trials. Before the war we often drew attention to Germany's lavish expenditure on the testing of her naval weapons. It was the invariable practice there to make exhaustive tests of every class of material before finally accepting it for naval purposes. No new gun was adopted until it had been tried under conditions resembling as nearly as possible those of actual war. New projectiles were fired against targets representing the most strongly armored ships of the day, and if they failed to do all that was expected of them an improved type was at once designed. In this way the Germans had evolved a shell that would carry its powerful bursting charge through the thickest armor, while we had no thoroughly reliable A. P. shell until the third year of the war. The same policy of striving for maximum efficiency, regardless of trouble and cost, was pursued in the development of gunnery, torpedoes, mines, and systems of armor protection. Of course, it was a costly business. Between

1908 and 1914 Germany is said to have spent four times as much money on this sort of thing as we did, but her method proved in the end to be the most economical.

In the light of present knowledge it can be asserted with confidence that had all our material been as technically efficient as Germany's was, the task of crushing her at sea would have been enormously simpler and cheaper. Experience that might have been purchased in pease time for a very modest sum had to be hurriedly acquired in war at a terrific cost. It is not enough that the navy has learned its lesson in this respect; public opinion also needs to be reminded that the mere voting of money for men and ships is not the whole of its duty to the service. It is for the Admiralty to insist on proper financial provision being made for the continuance, on a scale of reasonable dimensions, of the research and experimental work that was in full swing towards the end of the war. Unless this is done the priceless experience we gained from the war will be wasted. As the Admiralty have said, "To stop pure research work altogether at this moment would be a retrograde step, and might conceivably have a serious effect ultimately on development of types of ships and weapons, and on economy generally." Advantage might profitably be taken of the pause in new construction to press for an increase in next year's vote for "scientific research and experiment," which in the current estimates stands at about £285,000. This sum is so obviously inadequate as to suggest that the old penny wise pound foolish system is already in force once more.—*The Naval and Military Record,* August 18, 1920.

DEVELOPMENTS IN NAVAL DESIGN.—On the occasion of his recent visit to the industrial centers of Yorkshire, Admiral of the Fleet Lord Beatty made an important statement relative to naval policy. Speaking at Sheffield, he said that the history of the British Navy acquitted it of any taint of aggression, and was a sufficient guarantee that its powers would be exercised for the benefit of all those who used the seas for lawful purposes. Since the war, he proceeded, there had been no new construction; but ships did not last forever, and progress in science and in technique combined to shorten the "life" of a man-of-war. The Admiralty, however, took the view that we could afford to pause before resuming naval construction. The policy of the moment was to investigate the problems of war, and to assimilate and coordinate the lessons derived from experience, so that when the time came, as come it must, to turn those lessons to a useful purpose, they should be applied with wisdom and understanding. So far as facilities for experimental and research work were concerned, the navy was better equipped to-day than it had ever been before. He concluded by deprecating the wild and fantastic theories which had lately been propounded in certain quarters, "where surprise is felt that we are not to-day constructing big ships which would dive beneath the waves one minute and ascend into the clouds the next." The First Sea Lord's speech is a much needed reminder that our naval commitments did not terminate with the conclusion of peace. That we are able to postpone for a certain period the laying down of new warships is due, not to any fundamental change in the principles of national defence which hitherto have impelled us to maintain a supreme navy, but simply to the fact that our present margin of strength suffices to meet the requirements of the immediate future. Sooner or later, however, this margin will disappear—already it is shrinking visibly—and when that occurs it will be the duty of our naval authorities to submit a new shipbuilding program. Meanwhile the Admiralty, as the First Sea Lord assures us, is utilizing the pause to determine what modifications in ships, machinery and weapons may be indicated by war experience. It is quite clear that the present board is in no mind to dispense with the battleship altogether. Its views on the question were set forth in the First Lord's memorandum circulated on March 12. This document stated that the Naval Staff, having examined

the question with extreme care, profoundly dissented from the opinion that the battleship is dead and that submersible and air vessels are the types of the future. "In our opinion," it was added, "the capital ship remains the unit on which sea power is built up. So far from the late war having shown that the capital ship is doomed, it has, on the contrary, proved the necessity for that type."

We may, then, assume that capital ships will form part of the new naval program to be introduced when circumstances render it expedient, the more so because it is in this type that our lead is rapidly diminishing by reason of competition abroad; but no one outside the councils of the Admiralty is able to forecast the characteristics of our future ships. It is commonly supposed that H. M. S. *Hood* represents the last word in British naval design. This is an error, for the Assistant Chief of Naval Staff, Captain Sir A. Chatfield, has told us that if a new ship were to be laid down immediately it would not be a second *Hood*. He admitted that naval opinion no longer attached to high speed the importance that it did before the war, and that substantial protection was now considered an indispensable feature of every ship intended to lie in line. It would, however, be premature to conclude from this that the battleship of the future will be smaller and cheaper than the latest existing types. True, the demand for great speed has materially contributed to the enormous growth in dimensions, and when, as in the case of the *Hood*, that demand is coupled with a heavy armament and complete protection, it inevitably leads to huge displacements. But if the naval tactician is ready to forego high speed, it does not follow that he will consent to part with the extra percentage of displacement necessitated by installing high-powered machinery. On the contrary, he is more likely to resist a reduction in size on the ground that the weight saved on machinery can be profitably utilized by strengthening armament and protection. Nor would such an attitude on his part be unreasonable, for it is certain that the standard of offensive and defensive power, as represented by the *Hood*, will have to be raised if our future designs are to bear comparison with the best foreign ships. A "modified *Hood*," mounting the same armament as that ship and embodying the same system of protection, but with a speed of 25 knots instead of 31, might be built on a displacement of 32,000 tons, as against 41,200 tons; but if an extra pair of guns and a few extra inches of armor were postulated the figure would probably rise of 40,000 tons, if not more. As evidence that high speed is not necessarily the capital factor in determining size, we may instance the new American battleships. The *North Carolina* is not a particularly fast ship judged by modern ideas, for her machinery is estimated to develop 60,000 shaft horsepower for a speed of 23 knots; yet she displaces no less than 43,500 tons, or 2300 tons more than the *Hood*. In this case most of the weight has gone into artillery and armor. The *North Carolina* is to be armed with twelve 16-inch 50 caliber guns, and sixteen 6-inch quick-firers, which—counting the primary armament alone—will enable her to deliver a broadside of 25,200 lbs., as against the *Hood's* 15,360 lbs. Her belt armor is reported to have a maximum thickness of 16 inches, and all the main fighting positions to have equally substantial protection. It is obvious, therefore, that except in the matter of speed this American vessel will possess a marked tactical advantage over the *Hood*, and speed, as we have said, is an element to which British naval opinion no longer attaches cardinal value.—*The Engineer*, August 13, 1920.

ADMIRALTY CONCESSIONS TO THE LOWER DECK.—The decisions by the Admiralty on the requests put forward through the Welfare Committee in October, 1919, are promulgated in Fleet Orders. Altogether 307 requests,

great and small, were put forward, 80 of which were of a general character and the remainder appertaining to particular classes. Each request has been carefully considered by the Board, and over 100 have been granted in whole or in part. In certain instances decisions have yet to be announced, many questions to which they relate being under consideration by special committees.

The principal benefits granted as a result of the welfare system during the year are set forth as follows:

(a) Permanent institution of marriage allowance.

(b) Increase of provision and long leave allowance from 2s. 1d. to 3s. 6d. a day in view of the present high cost of living.

(c) Improvements to be made in men's accommodation both in ships and shore establishments.

(d) Change of uniform for petty officers over four years.

(e) Improved scales of pension for service for men invalided for war disability.

(f) Concession to old roll pensioners.

To a request that the mate scheme of advancement from the lower deck to commissioned rank should be open to all branches, with a few exceptions, the Admiralty reply that they are not prepared to extend the scheme to other than the seaman and engine-room branches, and the number of ratings advanced must depend on the requirements of the service. It is clear from the number of requests involving the principle of automatic promotion that there is a considerable body of feeling among the men in favor of it. The Board, however, are of opinion that automatic promotion is not in the interests of the Service.—*The United Service Gazette*, Aug. 12, 1920.

JAPAN

JAPANESE BUILDING PROGRAM.—Much interest has been aroused in this country over the Japanese naval building program which calls for the construction of eight superdreadnoughts and eight battle cruisers—the eight-eight program, as it is termed. Information at hand shows that the battle cruisers of the *Akagi* and the *Amagi* type, are to be smaller by more than 3000 tons than the American dreadnought battle cruiser Saratoga and her class.

The *Akagi* and the *Amagi* are in a class of four under construction, the others being the *Atago* and the *Atako*. Four similar vessels are projected. Figures obtainable show the following comparative measurements of the *Akagi* class with the *Saratoga* class:

Akagi class—full load displacement, 40,000 tons; speed, 30 knots per hour; main battery, eight 16-inch guns; shaft horsepower not definitely known. One report is that the shaft horsepower is 250,000, but this is not believed, as the larger vessels of the *Saratoga* class are to be faster than the *Akagi* class with much less horsepower than 250,000.

Saratoga class—full load displacement, 43,500 tons; speed, 23.25 knots per hour; main battery, eight 16-inch guns; shaft horsepower, 180,000.

The Japanese dreadnoughts *Negato* and *Mutsu* are compared with the ships of the American Colorado class in that they are of the same classification and almost of a size. The Japanese vessels will have a slight advantage over the Colorado class in displacement and more than two knots better speed. The comparison follows:

Colorado—Full load displacement, 33,590; speed, 21 knots main battery, eight 16-inch guns.

Negato and *Mutsu*—Full load displacement, 33,800; speed, 23.5; main battery, eight 16-inch guns.

The Japanese vessels are supposed to be four-turbine ships. The *Negato* was launched on Nov. 16, 1919. The *Mutsu* was launched on May 31, 1920. The material for two other vessels of this class is being assembled. Four others are scheduled for completion in 1929. Of the battle cruisers of the eight-eight program two are being built to be completed by 1923, two others have been authorized and four are projected. These last mentioned six should be completed by 1927.

A comparison of the United States and Japanese battle fleets in 1923 will show the following:

United States—Battleships, 17; 14-inch guns, 84; 16-inch guns, 104; displacement, 624,074 tons.

Battle cruisers, 6; 14-inch guns, 0; 16-inch guns, 48; displacement, 261,000 tons.

Total weight of broadside fire of American battle cruisers, 98,304 pounds.

Japan—Battleships, 8; 14-inch guns, 48; 16-inch guns, 32; displacement. 258,860 tons.

Battle cruisers, 6; 14-inch guns, 32; 16-inch guns, 16.

Total weight of broadside fire of Japanese battle cruisers, 76,704 pounds.

In the seventeen battleships of the American fleet, built and building, are six vessels of more than 40,000 tons displacement. All are included in the program to be completed by 1923. In addition to these the United States is building four battleships of more than 33,000 tons.

All the new super-dreadnoughts of more than 33,000 tons and more than 43,000 tons will carry batteries of 16-inch guns, the four ships of the *Colorado* class having eight each and the six ships of the *South Dakota* class having twelve each.

The *Saratoga* class of battle cruisers, which the Navy Department hopes to complete by 1923, comprises six vessels. The American Navy has no battle cruisers in commission.

Under the intensive Japanese building program, eight battleships and six battle cruisers are to be completed by 1923 and it is expected that the rest of the Japanese program for capital vessels—those capable of going into the first battle line—will be completed in 1927 with twelve battleships and twelve battle cruisers added to the fleet. In addition, the Japanese program calls for eight high speed cruisers of 6000 tons, twenty-four light cruisers of 5000 tons, thirty-two destroyers of 1300 tons, thirty-two destroyers of 850 tons, twenty-four submarines of 1300 tons, forty submarines of 800 tons, and twelve special duty ships of about 12,000 tons.—*New York Times*, Aug. 27, 1920.

JAPANESE LAUNCHINGS IN FIRST HALF-YEAR.—The number and tonnage of ships of over 1000 tons gross launched in Japan during the first six months of 1920 were as follows:

Month	Number of ships	Gross tonnage
January	6	25,605
February	7	41,415
March	13	58,330
April	12	56,725
May	10	51,850
June	8	32,770
Total	56	266,695

—*The Nautical Gazette*, Sept. 9, 1920.

UNITED STATES

NAVY DEPARTMENT—BUREAU OF CONSTRUCTION AND REPAIR

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—DEGREE OF COMPLETION, AS REPORTED AUGUST 31, 1920

Type, number and name	Contractor	Per cent of completion			
		Sept. 1, 1920		Aug. 1, 1920	
		Total	On ship	Total	On ship
Battleships					
44 California	Mare Island Navy Yard	93.6	91.8	92.9	90.9
45 Colorado	New York S. B. Cpn.	57.6	51.4	55.1	46.3
46 Maryland	Newport News S. B. & D. D. Co.	79.4	77.9	77.7	75.9
47 Washington	New York S. B. Cpn.	50.2	39.8	48.9	37.8
48 West Virginia	Newport News S. B. & D. D. Co.	32.5	17.5	31.5	15.5
49 South Dakota	New York Navy Yard	14.5	6.7	13.3	5.5
50 Indiana	New York Navy Yard	11.5	3.7	10.9	3.1
51 Montana	Mare Island Navy Yard	11.2	4.	11.	3.4
52 North Carolina	Norfolk Navy Yard	14.7	8.6	14.1	7.9
53 Iowa	Newport News S. B. & D. D. Co.	6.5	4.1	4.5	3.5
54 Massachusetts	Beth. S. B. Cpn. (Fore River)	....	......	....	....
Battle Cruisers					
1 Lexington	Beth. S. B. Cpn. (Fore River)	1.3	.3	.7	....
*2 Constellation	Newport News S. B. & D. D. Co.	.9	.1	.7	....
3 Saratoga	New York S. B. Cpn.	3.1	.4	.7	.2
4 Ranger	Newport News S. B. & D. D. Co.	.7	......	.7	....
5 Constitution	Phila. Navy Yard	1.	.3	1.	.3
6 United States	Phila. Navy Yard	1.	.3	1.	.3
Scout Cruisers					
4	Todd D. D. & Const. Cpn.	64.9	54.	58.5	4[illegible].2
5	Todd D. D. & Const. Cpn.	56.1	44.4	51.3	36.6
6	Todd D. D. & Const. Cpn.	37.4	14.8	34.4	10.7
7	Beth. S. B. Cpn. (Fore River)	13.3	6.6	8.7	4.6
8	Beth. S. B. Cpn. (Fore River)	12.6	5.9	8.7	4.6
9	Wm. Cramp & Sons Co.	52.	......	48.	....
10	Wm. Cramp & Sons Co.	51.	......	47.	....
11	Wm. Cramp & Sons Co.	27.	......	20.	....
12	Wm. Cramp & Sons Co.	28.	......	20.	....
13	Wm. Cramp & Sons Co.	21.	......	20.	....
Miscellaneous					
Fuel Ship No. 17, Neches	Boston Navy Yard	95.	94.3	88.9	87.8
Fuel Ship No. 18, Pecos	Boston Navy Yard	36.	29.	32.3	24.5
Gunboat No. 22	Charleston Navy Yard	58.4	46.1	54.1	41.1
Hospital Ship No. 1, Relief	Phila. Navy Yard	96.5	95.5	94.	92.5
Amm. Ship No. 1, Pyro	Puget Sound Navy Yard	Comm.	8/10/20	99.9	99.9
Amm. Ship No. 2, Nitro	Puget Sound Navy Yard	98.9	96.6	98.5	95.5
Rep. Ship No. 1, Medusa	Puget Sound Navy Yard	53.5	43.5	53.	43.
Destroyer Tender No. 3, Dobbin	Phila. Navy Yard	29.7	29.	27.2	26.
Dest. Tender No. 4, Whitney	Boston Navy Yard	1.5	1.	.5	.5
Sub. Tender No. 3, Holland	Puget Sound Navy Yard	5.5	......	5.	....
Oil Tankers					
1660 Tippe Canoe	Newport News S. B. & D. D. Co.	Del'd	8/4/20	99.	......
1661 Trinity	Newport News S. B. & D. D. Co.	99.	......	95.	......

Authorized but not under construction or contract:

(1) Transport No. 2.

NOTE: Airplane Carrier U. S. S. Wright will probably be delivered to the contractors for conversion October 15, 1920.

* Keel laid August 18, 1920.

In addition to the above there were under various stages of construction 60 destroyers, 49 submarines and 3 sea going tugs.

In addition to the ships noted in the tables, there were commissioned or delivered to the Navy Department during August 6 destroyers and one sea going tug.

There are authorized but not under construction or contract 12 destroyers and 7 submarines.

AMERICA AND POLAND.—It is one of the tragedies of the world we live in to-day that it produces no statesman of vision. The course events in Russia were taking was plain when the war ended. But the peace was made in a cloud of words and phrases as if the catastrophe in the East had no meaning for the West. The United States, being furthest away from it, has placed herself in a more difficult position than any of the other Allies for dealing with it. But there is a very real fear in American official circles of Bolshevism spreading across the Atlantic. That is why Mr. Colby, the Secretary for Foreign Affairs, whose views are also those of the President, has sent such a strongly worded Note to the Italian Government, who asked for the Washington standpoint in the matter. In it Poland's independence is upheld and the Soviet Government denounced as a menace to all moral, political and social principles upon which our civilization is based. Since the Senate has hung up the Peace Treaty the United States can give little practical effect to her policy. She cannot send naval or military aid, munitions, or arrange for a financial loan. But the Note definitely places her on the side of France as opposed to entering into any relations with the Terrorists, and gives Poland moral support at a very critical moment. It clears the air considerably, too, that the Government of a Great Power, and one whose democratic basis is so solid, should speak out plainly on the true nature and aims of Bolshevism. As in the Great War, so in the struggle which is just beginning, America, if slow in taking an active part, is quick to show where her sympathy lies.—*The Army and Navy Gazette*, Aug. 21, 1920.

IS NAVAL DESIGN IN THE FLUX?—Are naval design, construction, strategy and all the rest of it in a state of flux? When Beatty led the German fleet into contact with the British, Jellicoe, with twenty-five battleships, had the speed and power to close in and absolutely annihilate the Germans. Why did he not do so? Because of his very proper fear of the torpedo. He escaped torpedo damage by keeping the German destroyers at such a distance that their torpedoes were discharged haphazardly, lost their speed before they reached the British line, and were easily avoided by maneuvering.

Have you ever considered that the gas engine is liable to upset many of the theories and practices of naval construction and warfare? It is a thought well worth consideration, and we invite attention to it just now.

Is it not rather strange that the British should have scrapped half their battleship fleet and stopped all battleship construction? And that they should so complacently sit down and watch another navy spending seven hundred and fifty million dollars on eighteen battleships and battle-cruisers which, theoretically, when completed, will wrest from her that protective supremacy at sea which she has always believed, and still believes, to be necessary to the security of her far-flung empire? Why this complacency? If you asked Admiral Benson, he would probably answer: "They are hard up. It is necessity." But can we be so sure of this? Is it not possible that their vast war experience showed the British that the terrific punishing-power of the torpedo, due to new methods of bringing it within point-blank range of the enemy, demands a radical revision of some of our fundamental war concepts?

We believe that in future war the torpedo will at last come into its own, and it will be the internal combustion engine that will work the change. It gave us the motor car and the airplane, and now it is perhaps destined to

dethrone the battleship and battle-cruiser as the supreme elements of naval strength. But how? Well, the British have several large and fast torpedo-plane carriers. Let us forecast a duel between a twelve-gun, 23-knot *Massachusetts*, and a 32-knot torpedo-plane carrier, with twice that number of planes aboard. Steaming outside of 16-inch gun range, the carrier would send in her planes which, swooping down from great height at 150 miles an hour, would drop their torpedoes within close range and return for more. But the bulge will save the ship? No; for the torpedoes will be set to pass underneath the ship and they will be fired magnetically by the action of the steel mass of the ship itself. And you could not put side and bottom bulges, both, upon a ship—she would be all bulge and but little ship.

Again, the internal combustion engine has opened up another form of attack in the shape of the so-called one-man torpedo boat—a type which is coming along very fast. It begins to look as though the gas-driven, high speed, motor boat, carrying its torpedo discharge below water, would fulfil the functions in which the torpedo boat failed utterly and the destroyer partially. It has the torpedo efficiency of the destroyer without its size and visibility. To hit, the torpedo must be fired at close range—the Germans found that out at Jutland. The torpedo motor boat is so small a mark that it can dash in at thirty knots to within point-blank range without the anti-torpedo gunner being able to draw a bead upon it, so rapid is the change of range; and twenty sea-going motor boats can be sent in for the cost of one destroyer.

Seaworthiness? Well, they are growing in size, and the latest type would have no difficulty in keeping station as part of a fleet organization.

There are evidences, clear to the close student of naval development, that naval theory, construction, strategy and tactics are very much in the flux just now, or soon will be.—*The Scientific American*, Aug. 14, 1920.

THE DESIGN OF WAR VESSELS AS AFFECTED BY THE WORLD WAR. (Rear Admiral David Watson Taylor, Chief Constructor U. S. N.).—The Battle of Trafalgar was fought October 21, 1805, or early in the nineteenth century. In the early part of the present century the tactics employed in that battle were still being discussed, but although Nelson's Flagship, the *Victory*, is preserved by England at Portsmouth, it is of no interest from a material point of view to designers of war vessels of the present day. Similarly, with the rapid engineering development of naval material which has been going on for more than 50 years and bids fair to continue, the material lessons from the World War must be gathered within a comparatively short time. Even so, to answer fully the question, "What has been the effect of the World War on warship design?" is not as yet possible. For years it will be necessary to collate and study an enormous mass of experience, some written, some oral, some originating from the responsible controlling bodies of the great navies, and much from individuals, including not only those of great eminence, but many whose names will never emerge from comparative obscurity, though their experience in the aggregate may in the long run exercise a dominating influence.

As a practical proposition the full effect of war experience will be demonstrated in concrete form only after service opinion has been crystallized and become definite in direction as a result of study and discussion by a large number of officers. Certainly that will be the case in the American Navy where the organization is such that service opinion necessarily controls policy in the development of naval types. The service is a customer of the naval designer, and although the latter may influence and at times interpret and lead service opinion, the customer will have what he demands. What I say to-day must therefore be taken more in the light of a discussion of this intensely interesting subject, than as a hard-and-fast laying down of principles or expressions of final opinion.

Let me call attention at once to the fact that, after all, there has been nothing startling or revolutionary brought about by the experience of

51 months of war. There has mainly resulted an intensive development of each of the accepted types which existed at the outbreak of the war and which were the results of many years of study, experiment, and practice in all of the great navies of the world. It is true that some new types have appeared, but with one exception, namely, aircraft carriers, they have been of minor importance when measured by the cost and time required for production.

When we consider types and not details, we must not look only to the few naval battles of the World War which can justly be classed as major actions for the influences affecting our naval construction of the future. It is necessary to consider the particular trend of naval events, the accumulated experience, and the principal phases of naval activity during the more than four years of hostilities.

The first of these must naturally be the causes which gave not only the initial but the continuing command of the sea to the Allies. We know that at the outbreak of the war all German mercantile vessels quickly disappeared from the high seas, being either held in their own ports or promptly interned in neutral ports. On the other hand, Allied commerce proceeded on its way. It was not the great British Battle Fleet which the German merchantmen feared, for they knew that this fleet would be concentrated at one point within easy striking distance of the German coasts and therefore it could be easily avoided. What they feared were the Allied cruisers, auxiliaries, destroyers and light vessels of every class. Just as the few German cruisers which were at large were captured or sunk within a few months, so could this cloud of Allied light craft have been swept from the seas had the German heavy fighting forces been able operate without first giving battle to the superior British Battle Fleet. They were unable to do this at any time during the war. As a result every military effort of the Central Powers afloat and ashore was made more difficult because of the slow but sure throttling of their economic and industrial life. Without the British Battle Fleet the blockade of Germany would have been ineffective. This factor had such a determining influence, both on the duration and final outcome of the war, that the types of vessel which make up the main fighting fleets are more firmly established than ever as the essential ones contributing to naval power. If these great battleships and battle cruisers disappear, either in the near or the distant future, it will be as a result of engineering progress and the invention and perfection of new weapons and not as a result of the World War.

Battleships and battle cruisers were in actual conflict with vessels of the same type and power on only two occasions: at the Dogger Bank on January 24, 1915, and at Jutland on May 31, 1916. These actions, however, do not by any means represent the sum total of their activity. When the location and activity of the German Cruiser Squadron in the Pacific was disclosed by the tragedy off Coronel, two battle cruisers at once sailed to search out and destroy this troublesome squadron. Perhaps they were lucky in coming into contact with the enemy immediately, but the celerity and success with which they accomplished their mission at the Falkland Islands gave a great impetus to the favor in which this type was held by naval men. The immediate effect of this sentiment was seen in the British battle cruisers *Repulse* and *Renown*, which represent the extreme of the type; that is, armor and gunpower were sacrificed to speed to an even greater extent than in the original battle cruiser. These were quickly followed by an even greater extreme, the *Courageous*, *Furious* and *Glorious*, which can be denominated either small light battle cruisers or enormously large light cruisers, as they have the largest guns characteristic of the former and the total absence of armor protection characteristic of the latter, while possessing the high speed common to both. The battle off Dogger Bank served only to confirm the conclusions on which these two classes of ships had been laid down. In this engagement, the rival battle cruisers met for the first time, with the result that those on both sides demonstrated their

ability to stand heavy punishment without succumbing to fatal damage. Even the older German cruiser *Blucher*, which was inferior in gunpower, protection and speed to all of the others, succumbed only after surviving for a considerable period of extremely heavy punishment. If there had been no further war experience with the battle cruiser type it is likely that the idea that protection is not important for them would have prevailed, and the combination of extreme speed, guns of the largest size, and the minimum of protection might have been in favor for some years. But the Battle of Jutland gave a rude shock to opinions based on earlier actions.

The Battle of Jutland is easily the foremost single event of modern naval history. The controversial phases of the tactics employed in this battle are only of interest to the naval designer in so far as the material in the two fleets influenced the judgment and decisions of the high command on each side, and to the extent that new instruments of naval warfare, not then available but developed since, would have exercised a determining influence in the tactics employed; in the latter class comes the use of aircraft, and I will have occasion later in this paper to refer to the use and influence of aircraft in naval operations from the designer's point of view. By far the most important aspect of this engagement to the designer is the manner in which the various types of vessels engaged fulfilled the functions for which they were originally designed. In regard to type, the first outstanding fact is that battle cruisers must inevitably play an important rôle in major fleet actions. Each side in turn, first the Germans and then the British, used their battle cruisers to lead the whole or a portion of the enemy's fleet to contact with the main body of their own fleet. In fact, with the single exception of the *Warspite*, it was the battle cruisers on both sides that stood the brunt of the action and received the lion's share of punishment from the enemy. If the battle had been fought to a finish between the battleships, there might have been a different story to tell. The losses and heavy damages sustained by the vessels of battle cruiser type bear out to some extent the pre-war contentions of those who maintained that it was not fit to take its place in the line of battle. On the other hand, excepting their greater vulnerability, it cannot be denied that they acquitted themselves with credit even when pitted against the more heavily armed and armored battleship. Furthermore, not only was the value of their great speed demonstrated, but also the value of one side holding the speed gauge over the other was shown, for, it was due to the possession of higher speed by the British that the German Fleet, at the end of the second phase of the battle, found itself in a position which was so bad tactically that the German Chief-of-Staff is quoted as saying that if any admiral had involved himself in such a position in peace time maneuvers he would never again have obtained a command afloat. Another result from this action of general influence on type is found in connection with the use of older battleships, generally referred to as of the "pre-dreadnought" era. The German Fleet included one squadron of vessels of this type, and this squadron not only failed to be of any essential assistance to them but proved actually to be a handicap on their freedom of maneuver. The force of this lesson was shown by the fact that subsequent to the battle most of the German battleships of this type were retired from active commission. The material weakness of this type of older ships, when opposed to the most modern weapons, was shown in the case of the *Pommern*, which blew up and sunk immediately as a result of a single torpedo. The ineffectiveness of these older ships, as shown by many incidents of war, will be referred to later.

The ability of the large, modern, heavily-armored ships not only to survive, but to continue in action after the most severe punishment, was perhaps best shown by the British battleship *Warspite*, which, due to an unfortunate accident to the steering gear, sheered out of the battle line and made two complete circles within short range of the German Fleet. This vessel was hit by major caliber shell between 20 and 25 times. The net

result of this tremendous hammering was that one out of eight 15-inch guns was put out of action; there was no damage of any kind to her main machinery plant; the upper works and unprotected portions of the ship were riddled; communications were interrupted to a considerable extent; and some compartments at and below the waterline were flooded by water which came in from above, but none of the main compartments were affected to such an extent that the entering water could not be handled by the pumping arrangements provided. In short, although the ship had lost a certain amount of her margin of safety, due to decreased buoyancy and stability, and her speed had suffered on account of increased resistance due to her greater draft, she was entirely capable of resuming action after adjustments to her steering gear.

The *Marlborough* was another example of a battleship continuing in action after receiving what we were inclined formerly to consider would be a disabling attack. This vessel, although of the "dreadnaught" era, has not what is now considered a highly efficient form of protection against torpedo attack, yet, after being struck by a torpedo, resulting in the flooding of a number of compartments, which produced a list of about 7 degrees, the vessel continued in action at a speed of 17 knots.

Similarly, the German battleship *Ostfriesland* (of the "dreadnaught" era) was struck by a torpedo which produced some flooding, but the vessel was otherwise unaffected and continued on with the German Fleet.

No other British battleships received any considerable amount of punishment, but three of the modern German ships of this class received, respectively, 7, 7 and 13 hits from major caliber guns, but none of them were disabled or even damaged to an extent sufficient to prevent them continuing in action. The *Markgraf*, which was struck 13 times, is a particularly illuminating example of the amount of punishment which a modern heavily armored ship can stand. The only damage affecting the efficiency of the ship was the cutting of the communications from the masthead fire control positions, and this only resulted in shifting the control to the lower armored station provided for this purpose. The casualties on this ship were likewise remarkably low, as there were only 8 dead and 9 wounded, or only a little more than one casualty for each major caliber hit.

One particular class of hit of special interest to American designers is that in which turrets or their barbettes have been hit. Taking the case of four British and four German vessels which suffered heavy damage, it is found that out of a total of about 116 hits, 19, or 16.5 per cent, were on turrets or barbettes, of which 16 were struck. Of this number, four were completely put out of action and one gun in each of four others was disabled, while the remaining eight escaped without serious damage. In other words, out of 66 big guns carried by these ships, the emplacements of 32 were struck, but only 12 were sufficiently damaged to prevent their further use. This comparatively low proportion of casualty in the major offensive armament, together with the demonstration of the ability of the mechanism of a turret to continue to function even after the turret has had a direct hit, appears to dispose of the argument of "too many eggs in one basket" so frequently advanced against the American three-gun turret.

Turning to the damage sustained by the battle cruisers, one's attention is naturally taken first by the tragic loss of the three great British vessels of this type. Although in one case the Germans claimed a torpedo hit on one of them, it is generally accepted that the loss of all three was directly attributable to gunfire, but the immediate cause of the loss in each case is still, and always will be, shrouded in mystery. It is, of course, known that each one sank in an appallingly short interval of time and that in each case at least a portion of the magazines blew up. The mystery lies in the immediate cause of the magazine explosion. Many different explanations have been advanced, but all of these affect details rather than the general characteristics of type. There seems little doubt that one of two things happened: German shell either entered the magazine through penetration of

the protective deck, or, having pierced turret or barbette and exploded, flame was communicated to the magazine along the path followed by the ammunition from magazine to gun. From the fact that in the case of British ships that survived, there was only one case of penetration below the protective deck at any part (no harm resulted from this), it would seem to be highly improbable that the three battle cruisers were all sunk by protective deck penetrations directly over the magazines, and not very probable that any one of them was so sunk. We must not permit our judgment to be swayed too largely by this particularly spectacular phase of the battle. Just as in the case of the battleships previously referred to, the remaining battle cruisers on both sides demonstrated ability of modern ships of large size to withstand heavy punishment without losing their fighting efficiency. The battle cruiser type is essentially and unavoidably less thoroughly protected than the battleship type. This greater vulnerability must result in greater loss of the battle cruiser type, other things being equal; but in the Jutland fight the battle cruisers were engaged much longer and much more severely than the battleships, so that a greater percentage of loss of this type should have resulted even had their protection been equal to that of the battleships. A notable fact in regard to the modern ships, both battleships and battle cruisers, on both sides, is that not a single one experienced a disabling casualty to its machinery, either as a result of damage from enemy fire or as a result of engineering breakdown. In the case of one British ship and one German ship, fires were drawn from under the boilers in one fireroom, due in each case to leakage from adjacent compartments, but in each case this leakage was controlled by the pumping plant provided for the purpose. Leaving out the three lost battle cruisers, for which no data is available, the dozen large ships in the two fleets which bore the brunt of the punishment were hit a total of about 150 times by large caliber shell, or an average of more than 12 times each. Only one of these dozen ships, namely, the German battle cruiser *Luetzow*, sunk as the result of the damage received. Even this vessel sank only after six hours. She had received 17 large caliber hits and one torpedo. She continued to try to make the best of her way to port, but the struggle was given up about one o'clock in the morning; her crew was taken off by destroyers and she was finally sunk by a friendly torpedo.

The results of the battle, as a test of the defensive qualities of capital ships, show that in the entire action only four modern armored ships, all of them of the battle cruiser type, were lost as a result of the action. This was out of a total of 14 engaged and at least seven out of the remaining 10 survived heavier punishment than most designers in pre-war days would have considered possible.

Before the war there were two distinct schools of naval thought in regard to the main armament for the largest fighting ships. This difference of opinion existed internally in probably every navy, but internationally the American and British navies represented the "Big Gun" advocates, as is shown by the fact that in the former we find successive increases from 12-inch to 14-inch to 16-inch, and in the latter from 12-inch to 13½-inch to 15-inch. On the other hand, the Germans adhered for a number of years to the 11-inch gun and increased their caliber to 12-inch with apparent reluctance, and a larger caliber did not appear until close to the end of the war. There were undoubtedly excellent theoretical arguments on both sides of this contention. Even now the argument cannot be definitely settled in terms of absolute material results, for too many other factors, which cannot be eliminated, enter into the problem. A convincing answer, however, appears to be provided in the very decided trend of German Naval opinion since the Battle of Jutland. Practically every report from German sources and every German publication bearing on the Battle of Jutland lays stress on the superiority in range and accuracy of the British 15-inch guns. Even if no definite material advantage for the larger caliber gun could be established, there appears to remain a marked moral superiority on the side

possessing the biggest guns. This, of course, only confirms the previous views and policies followed in our service.

Summing up, therefore, we find that four outstanding facts of interest to the designer appear to emerge from the smoke and flames of the battle:

First. The value of armor protection.

Second. As a corollary to this, the necessity for the maximum number of major caliber guns; for, if the modern ship can withstand great punishment, we must, for purposes of offence, provide a sufficient number of guns to inflict a degree of punishment which will be fatal.

Third. The tactical value of speed.

Fourth. The futility of subjecting older ships to the attack of modern weapons.

In other words, the value of each one of the three major elements entering into capital ship design was demonstrated and it cannot be said that any single one has emerged with an importance transcending that of the others. If, however, one must choose among them, the consensus of opinion will probably attach more importance to protection than before the battle. This arises largely from two causes:

1st. The deep impression on the human mind by such an outstanding tragedy as the almost instantaneous loss of the three great British battle cruisers.

2d. The impression that German ships, generally speaking, stood punishment better than the English. Admiral von Tirpitz has been reported to have laid down as the fundamental principle of German design: That vessels before everything else must float; that they must not sink, and if possible, not even list, and that all else is of secondary importance.

This emphasis on the feature of protection is shown already by the intensified and successful efforts of both the British and the American navies to perfect an efficient form of torpedo protection. In this connection, I think I can safely say that both services have solved this problem so far as the torpedo has been developed to date. It is also interesting to know that during the war the two services frankly and fully compared their solutions of this problem, and that although the solutions differ radically in details, they do not differ much in underlying ideas and both are believed to be successful in result. This emphasis of the protective feature is further shown by the fact that our battle cruisers, whose construction was delayed, due to the necessity for our concentrating on the construction of torpedo craft and merchant vessels during the war, have been re-designed and given much heavier and more complete protection than was originally contemplated, accepting at the same time the slight decrease in speed necessitated thereby. We find precisely the same influence in the case of the latest British battle cruiser, the *Hood,* which was laid down shortly after the battle of Jutland and in which we find more than a 50 per cent increase in size as compared to the *Renown*, which I have previously referred to, an increase of protection almost to a battleship standard and a decrease in speed.

Turning to the lighter craft used in the Battle of Jutland, it will be found that at several critical times during the engagement both sides used their light cruisers and destroyers to obtain a tactical advantage. Each side likewise used craft of this character to repel the attacks of similar vessels of the enemy. Although the material effect was small, there being probably not more than six torpedo hits on the large vessels of both sides, the necessity for their use is clearly demonstrated not only by their success in obtaining certain tactical advantages, for which they were used, but also in the demonstation that if either fleet had been without these light craft, the torpedo casualties inflicted on the big ships by the light craft of the side possessing them would have been enormously greater. The losses of light

cruisers and destroyers on both sides were heavy in actual number, but not in proportion to the total number engaged, as will be seen from the following table:

	Light Cruisers		Destroyers	
	No. lost	No. engaged	No. lost	No. engaged
British	0	26	8	78
German	4	11	5	77
Total	4	37	13	155

Submarines played no direct part in this battle, and it is reliably established that neither fleet was accompanied by submarines, nor were any submarines even within striking distance of the scene of action.

Similarly, aircraft played no part in the action, although it is understood that it was a part of the German plan to utilize Zeppelins for scouting purposes in connection with the sortie of the Fleet and that this was only prevented by unfavorable meteorlogical conditions on the 31st of May. On the following morning, however, German aircraft were out over the North Sea and were undoubtedly of some small assistance to the German Fleet in insuring their safe withdrawal to their harbors.

Passing once more to the general phases of the war, we come at once the outstanding feature of the war at sea, the submarine campaign and the methods adopted to combat it. Now that the veil of secrecy has been lifted, we all know how close the German submarine campaign came to being an outstanding factor in the final result. Without entering into the legality and ethics of the German use of the submarine against merchant shipping, which all thoughtful and enlightened men join in condemning, we cannot escape the fact that we must in the future be prepared to find the submarine playing an important part in attacking and throttling enemy commerce, even on their own coasts. This is indicated by the result of the discussion at the Peace Conference when the world at large was so incensed by the barbarous methods used in the German submarine campaign that proposals were seriously put forward to abolish the submarine entirely by international agreement. This proposal, however, was wisely not adopted for, so long as the possibility of war remains, progress of science and engineering and their application to the art of war cannot successfully be throttled unless there is complete unanimity of sentiment throughout the civilized world. The use of submarines during the war has led to placing very great emphasis on the value of radius of action of these vessels, and with radius of action there must go hand in hand improvements in the living conditions on board, so that the physical endurance of the personnel may be sufficiently conserved to permit it to make full use of the material capabilities of the vessel. Both of these elements, even without the usual and concurrent demands for higher speed and greater offensive power, inevitably lead to increased size, except for a limited class of small boats, which, due to a particular strategic situation, such as that occupied by the Germans on the Belgian Coast, makes it possible to use with good results a large number of submarines of small size and limited speed and cruising radius. The technic of mine-laying has, during the war, so kept pace with the strategical and tactical demands for the use of this weapon, that the demonstrated practicability of laying them on the enemy's coast by means of submarines must in the future be taken into account, but this does not affect the general characteristics of the type, as the mine-laying feature can easily be substituted in whole or in part for the torpedo armament. Although the submarine was throughout the war something of a disappointment in the actual results which it obtained in inflicting loss or damage on the fighting ships of the enemy, its indirect effect on the freedom of the action of the main fighting fleets was so considerable that the problem of the development of the so-called fleet submarine is still with us and must be solved largely from theoretical and

engineering considerations, rather than from direct experience in action. Another use of the submarine, not largely foreseen, which developed considerable importance during the war, is that of scouting. It has been conclusively demonstrated that these underwater craft form one of the most valuable assets to a navy in obtaining and transmitting information in regard to the movements of the enemy's forces.

War experience developed and emphasized certain facts regarding submarines as a type which are very important from the point of view of a designer, and even more important from the point of view of those who have to determine the constitution of a navy. The submarine is essentially an instrument of stealth. Once detected, it must take refuge in the depths where, for any design not yet known, its offensive powers become nil, and to the depth charge or explosive bomb developed during the war it is exceedingly vulnerable. In other words, once detected and accurately located, a submarine is at the mercy of a surface vessel. While detection devices, in spite of the enormous effort expended upon them during the war, did not reach perfection, they made much progress and will undoubtedly be steadily improved as time goes on. If we had to-day an accurate device which would locate a submerged submarine with reasonable approximation several miles off, and with accuracy when one or two hundred feet directly under the surface vessel, the submarine would be already obsolete as a weapon of war. While we may never reach this ideal, and while the submarine may be given offensive features to enable it to deal in some fashion with the surface vessel from beneath the surface, the submarine is essentially a vulnerable, and, if I may so express it, a precarious type; is necessary to-day and probably will be for many years to come, but could not be relied upon as the main feature of a navy. We read at times of proposed submersible battleships and other such imaginations, but the experience of the war does not seem to indicate this as a probable future development even if mechanically possible.

On this same subject Sir Eustace d'Eyncourt, the Director of Naval Construction for the British Admiralty, very recently stated his views in the course of a paper presented before the British Institution of Naval Architects. He said:

"A good deal has been written and talked of lately about the surface capital ship being dead and the necessity for submersibles. But with our present knowledge it would be quite impossible to design a submersible ship which on the same displacement and cost had anything like the fighting qualities on the surface, which are possessed by the *Hood* (the latest British battle cruiser). Every ship is a compromise, and if in addition to the ordinary qualities of a battleship, she is required to submerge, or even partially submerge, a very considerable percentage of weight has to be added to give her this additional capability of submergence. She becomes still more of a compromise, and the added weight must detract from the fighting qualities of the ship when on the surface, so that whatever is done, other things being equal, the submersible ship must be inferior to a surface ship in an ordinary action. There are many difficulties of details in the design of a submersible battleship which would take too long to go into fully now, and although there is no doubt that submarines are capable of great development, a little thought will make it clear to anybody that if naval warfare is to continue, the surface ship of the line must still hold the field as the principal fighting unit of any great navy."

Considering types of war vessels existing at the commencement of the war, the position of the destroyer has been enhanced perhaps more than that of any other, and this has been brought about by our experience in its use against the submarine. As mentioned above, in discussing the results of the Battle of Jutland, the destroyer has established its indispensability for use with the fleet, both to attack the enemy and to protect its own capital ships. This use, however, was foreseen and provided for to at least a limited extent in all of the principal navies of the world before the war. It was not, however, foreseen that this type of vessel would be required in undreamed-of

numbers to protect the sea lines of communication from the lurking underwater enemy. During the first three years of the war, it had already been found that the destroyer was the most efficient type of vessel for hunting down and destroying submarines, and for convoying or protecting a particularly valuable transport or cargo ship. In the spring of 1917, however, the losses of merchant vessels had reached such an alarming rate that the responsible authorities recognized that a new and radical method of protection must be adopted. It was then that the convoy system was put into effect, and soon proved its efficiency to a degree which could hardly have been foretold. It became then imperative that convoy should be provided as nearly as possible for every ship approaching England and France. The only available type of vessel which could perform this very arduous service, requiring many days continuously at sea in all kinds of weather, frequently at very high speed in order to accompany high-speed transports, was the destroyer. This demand placed a tremendous strain on the resources of the Allies in this type of vessel, and it is now a historic fact that the United States Fleet was stripped of its destroyers which were sent to the war zone to perform this service, and that British destroyers were detached from the combined British and American battle fleets, upon which we depended to maintain our command of the seas, until that fleet was actually seriously inferior to the German fleet in destroyer strength. From our entrance into the war the United States Navy concentrated upon destroyer building, its destroyer construction undertaken during the war being on a scale never before considered possible. It is a matter of congratulation that this has resulted in our now possessing a fleet built or to be completed this year, of more than 300 modern destroyers of the most efficient type. In regard to the effect of the war on the characteristics of destroyers, the principal demand has been in the same direction as in the case of submarines, namely, for greater cruising radius and increased shelter and comfort for the personnel. Whereas, during the greater portion of the time of actual hostilities, convoy was provided for transports and cargo vessels only in the so-called submarine zone, extending 300 to 400 miles off the European coast, it had become evident before the Armistice that as soon as we had sufficient destroyers for the purpose, escort would have to be provided, at least for the most important groups of vessels, entirely across the Atlantic. This was brought about by the ever-increasing tendency of the German submarines to operate farther afield and by the approach to completion of a very large type of cruiser submarine, which it had been known for some time was under construction in Germany in considerable numbers. The later United States destroyers would have been prepared to cope with such submarines, as the size of their guns had been increased from 4 inches to 5 inches. To obtain these increased qualities without considerable increasing the size of the boats, which was of course undesirable under the emergency demand for quantity production, meant the acceptance of a small decrease in speed. This we could accept with equanimity as our destroyers were already somewhat superior in speed to the latest types of corresponding size abroad.

The necessities of the anti-submarine campaign brought about new uses for several existing type of vessels, and the development of several new types. It had always been contemplated that fishing trawlers, drifters and other small vessels of similar type could be used in time of war as mine sweepers and tenders. With the development of the depth charge, a bomb containing about 300 pounds of high explosive with a detonating mechanism, which functioned only when it had sunk to a certain predetermined depth below the surface of the water, it became evident that any small type of vessel possessing the necessary seagoing qualities could be usefully employed against the submarine. As a consequence, this became the principal use to which these small fishing boats were put during the last year and a half of the war. They could not, of course, perform the high seas functions of the destroyer, but they proved most efficient for hunting operations

and for coastal convoy purposes. The esteem in which they were held is shown by the fact that in the summer of 1917 the British Navy put in hand a construction program of more than 500 of these little craft. The limitations on the use of the fishing boats and the limitations on the production of the destroyer, due to its large size and cost, resulted in the development of intermediate types which would give good seagoing qualities combined with a speed comparable to the surface speed of the submarines themselves, and at the same time sufficiently small and simple in construction to permit of their production in large numbers. The British patrol boats and the United States eagle boats are the principal examples of this type. The latter is really a small destroyer of 200 feet in length and 600 tons' displacement, having a good cruising radius and a speed of 18 knots and carrying an armament of two 4-inch guns with unusually good command and a large number of depth charges, together with the various devices for dropping or throwing these bombs. The British also developed and turned out a considerable number of a somewhat larger type, which were known as "Sloops," which were given a slower speed but a larger cruising radius, together with a more robust type of construction and special features to insure their buoyancy in case of damage by torpedo. All during the war, as previously referred to, the best scientific talent, both in this country and abroad, was making every endeavor to perfect devices which would permit a vessel on the surface to hear a submarine moving below the surface. Various types of these so-called listening gears were developed and some attained a sufficient degree of success to exercise a considerable influence on the development of types of vessels from which they could be used with the maximum of efficiency. It was in fact the development of these devices in America which led to the laying down of our eagle boats, and the machinery of these boats was designed with especial view to quick starting and stopping, so that internal noises should not in any way effect the use of the listening devices. Even before our actual entry into the war, it had become evident that it would be necessary for us to produce, in the minimum of time, the maximum number of vessels of every type which could be utilized against the submarine. This led to the planning of our program of sub-chasers. Earlier in the war, the British had purchased in this country over 500 gasoline-driven wooden hull boats of 85 feet in length for general coastal use. Their experience indicated that there was a distinct field of utility for vessels of this class, but that they should be of a somewhat larger size with better sea-keeping qualities. In order, therefore, to profit by their experience and at the same time to utilize the considerable resources in this country for the construction of small wooden-hull vessels, resources which were not required in the accomplishment of any of the various other war programs, we undertook the construction immediately upon entering the war, of 350 of these sub-chasers, each 110 feet in length, about 75 tons displacement, and having three 200-horsepower gasoline engines, giving a top speed of about 16 knots. They were fitted with special facilities for the use of various types of listening gear. They carried one small gun and a number of depth charges. In their seagoing qualities, these boats more than met the anticipations of their designers. About 200 of them crossed the Atlantic under their own power and performed most useful service in the Mediterranean Sea and on the French and English coasts. However, these boats must be regarded as stopgaps rather than a type to be found in large numbers in a permanent navy.

Another class of operation which resulted in the development of a new type, or rather the resurrection with new features of an old type, was the naval operations against shore fortifications. When the Germans had occupied the Belgian coast, it became evident that the navy must be prepared to undertake operations against that coast, unless the Germans were to be permitted to remain in undisturbed possession, allowing them an extremely undesirable freedom of action by using the ports as bases for submarines and destroyer activities. To meet this condition and the possibility of

similar conditions arising elsewhere in the vast theatre of the war, the British very early put in hand a number of modernized monitors, which repeated the well-known characteristics of the early American vessels of this class; that is, slow speed, the heaviest guns, armor protection, low freeboard, and small size, but added to these a modern and efficient form of torpedo protection; the last named really forms the *sine qua non* of the modern monitor, for it must of necessity operate off hostile coasts and by its slow speed is peculiarly liable to successful attack by submarines. These monitors at intervals throughout the war carried out a series of very interesting bombardments on the Belgian coast, which were accompanied by the use of such modern methods as spotting by means of aircraft and protection by means of smoke screens, produced by small fast boats accompanying them. In general, however, these operations failed to produce any decisive results, and this experience, combined with that gained through the attempts by older British and French battleships to reduce the fortifications of the Dardanelles, has gone far to confirm the opinion held prior to the war that ships cannot compete successfully with shore fortifications.

Although not productive of new types, and not, strictly speaking, exercising any influence on naval types, it is not possible to pass over the development of the transport service during the war, as its operations were on such an enormous scale. The British conveyed to and fro from the various theatres of war a total of something like 13,000,000 men, but the great bulk of these was for short distances across the Channel. The most impressive undertakings were the combination of the American and British resources, with some help from the other Allies, in transporting to Europe nearly 2,000,000 men during the war, and the bringing of them home in a period of a little over six months by the American Navy with some help from foreign sources. The enormous undertakings demonstrated that the great passenger vessels used commercially in time of peace can be quickly and efficiently converted for use as transports, and that, therefore, the naval designer need in the future only provide for the intelligent utilization of the great mass of experience accumulated in fitting merchant vessels for this purpose. As an example of the progress made in this direction in the course of the war, can be cited the fact that when some of the large passenger vessels were first fitted for use as transports, it was thought that they had been given the maximum troop capacity. After some months of experience, however, it was possible so to modify and perfect the arrangements that their capacity was increased in some cases as much as 50 per cent.

In reviewing the use of existing novel types during the war, one cannot omit reference to the active and important part played by certain types of auxiliaries. Colliers, tankers and supply ships were used to an enormous extent, but these are of such a purely merchant type that they require no especial note, except to remark that the few colliers we had built as naval auxiliaries, with special handling appliances showed up exceptionally well. The purely naval types which demonstrated their efficiency and value were the destroyer and submarine tenders and repair ships. One or more of these vessels were stationed at each one of our principal operating bases abroad, and without them our destroyer and submarine forces would have been unable to maintain their great efficiency and high percentage of time employed in active service. Due to the shortage of shipping, it was not possible to fit out and supply an unlimited number of vessels of this type, and it soon became evident that each existing unit must be utilized to its highest degree of productivity. This led to the erection on shore at the principal bases of barracks for housing the shop operating forces, so that the ships themselves could be run 24 hours a day, using three shifts of mechanics. This development leads to the belief that in the future in certain types of operation we may be led to provide special barrack ships for carrying and berthing sufficient personnel to utilize to the full the repair facilities provided on the vessels specially fitted for that purpose.

I have previously referred briefly to the development of the new and large type of naval vessel called an aircraft carrier. In the very early stages of the war, attempts were made to attack the principal naval bases in Germany by means of aircraft, but it was found that neither the aircraft themselves nor the commercial vessels hastily fitted up for the purpose of carrying them were sufficiently developed to permit of success in such an undertaking. I cannot in this paper take up in detail the wonderful development in aircraft during the course of the war, but the technical development resulting in increased size and speed and carrying capacity are well known. These were quickly taken advantage of by naval designers to fit them for such purely naval purposes as scouting, fire control of the heavy guns of big ships, torpedo carrying and launching, etc.

The actual offensive use of aircraft against naval vessels was little developed during the war. Perhaps the most prominent case was that of the *Goeben* which was ashore near the Dardanelles, and for six days exposed to aircraft attack, it being stated that some 217 bombs were dropped against her. There is no doubt that there will be a great development of aircraft for naval use as a result of the war experience, and some enthusiasts have visions of navies of the air rendering obsolete the navies of the ocean.

The United States Navy, which has in its own hands the development and control of its aircraft for use over the water, should take lead in any air naval development; but there is no doubt that, step by step with the air offensive, there will be developed a defensive. The defensive, moreover, will not be passive. We have seen in the late war how the light craft, destroyers, etc., on one side met and countered the attacks of similar craft on the other side. Had either side been deprived of its light craft, it would have been at most serious disadvantage. Similarly, developments in the air will undoubtedly be along the line of defending the capital ship by auxiliary and offensive aircraft. The big ship which must be protected from projectiles of a ton weight falling at angles of 30 degrees, fired from ships almost out of sight below the horizon, is not yet in serious danger from bombs carried by present-day aircraft, with chances of hitting small indeed.

At the moment it appears that the torpedo plane is the most promising development; its weapon of attack is the torpedo which the capital ship must already be prepared to defend itself from, whether fired by a surface vessel or a submarine. A torpedo from a ship in the air is no more deadly than from a submarine under the surface. It seems probable that aircraft will sooner become dangerous to destroyers and the vessels generally than to the large ships of the line. The former are more vulnerable and will be less able to protect themselves.

Even these early developments of naval uses for aircraft made it evident that they could not efficiently perform such functions with the fleet unless they could be carried with the fleet, not only on long cruises but actually in battle, with the result that special types of ships have appeared to fill this requirement. The first essential of this type is that it should be capable not only of launching aeroplanes but also of receiving them back after the accomplishment of their mission. With the present development of aeroplanes and seaplanes, the only practicable method of providing the latter requirement is the provision of an enormously large and absolutely clear deck upon which the planes can light and be brought to rest. The next requirement is that such a vessel shall have a speed sufficient to permit it to keep up with the main battle fleet when it is going into action. This means a speed of 20 to 25 knots. These qualities, together with the need for sufficient space to house and care for a considerable number of planes, together with their personnel, have resulted in vessels of 10,000 to 25,000 tons displacement. To obtain a clear upper deck requires special arrangements for funnels, navigating bridges, etc., which has resulted in the only absolutely new type of naval vessels of large size and cost which has appeared as a result of the war experience.

At the other extreme among new types appearing as a result of the war, comes what have been termed coastal motor boats. These appeared more as a result of possibilities presented by modern engineering developments than as a result of the need for filling a specific naval requirement. The perfection of the gasoline motor led in the years before the war to the construction, for sporting purposes, of very light high-speed small boats. Due to the fact that they were developed primarily for racing, they were suitable for use only in comparatively smooth water and had to be handled with extreme care. A study of their possibilities by British designers, supported by the enthusiasm of young naval officers, resulted in the production of boats of 40 to 70 feet in length and capable of speeds from 35 to 45 knots an hour, each carrying from one to three modern torpedoes, and with the hulls constructed on such scientific principles that they could go to sea in comparatively rough weather, and could be hoisted on board light cruisers or other types of naval vessels. These little boats performed splendid service off the Belgian Coast, and the tale of their operations forms one of the most exciting chapters in modern naval annals. But the most spectacular, and at the same time valuable service performed by boats of this type during the war, was the daring penetration by the Italians into a fortified Austrian harbor where they sank a battleship lying at anchor. Later, in operations against the Bolshevists, a small British flotilla penetrated to the inner harbor of Kronstadt, where they succeeded in sinking two battleships and two other large vessels.

I have several times, in the course of this paper, referred to the results experienced when war vessels of older types are subjected to attack by modern weapons. During the war there were sunk by hostile action 21 pre-dreadnaught battleships and 27 armored cruisers; of this total of 48, 11 were sunk by gunfire and 37 by mine or torpedo, only a single explosion in nearly every case being necessary to inflict the fatal damage. It is only necessary to refer briefly to such incidents as the sinking of the British battleship *Formidable,* the three cruisers *Cressy, Aboukir* and *Hogue,* the loss of four old battleships at the Dardanelles, the sinking of the *Gneisenau* and *Scharnhorst* off the Falkland Islands, the loss of the British *Hampshire,* and the American cruiser *San Diego* as the result of striking a single mine, together with numerous other incidents of similar nature, to show that such vessels as these, most of which were commissioned within ten years immediately preceding the war, are totally incapable of withstanding the terrific effects of present-day gunfire and torpedo attack. This showing is particularly impressive when compared to the demonstrated ability, as discussed above, of the most modern vessels to survive severe and repeated attacks. These qualities of resistance and defence can only be provided on vessels of large dimensions and displacement. The necessity for retiring these older types was well demonstrated by the fact that except for a few used for special purposes, both the British and the Germans had placed most of their older capital ships out of commission before the war had run its course.

To sum up, therefore, the experience of the war, so far as it can be grasped to date, has resulted in demands in the case of every existing type of war vessel which can only be met by increased size and cost. It has resulted in the introduction of only one new type of major importance, namely, the Aircraft Carrier, but it has introduced a number of small types which will probably survive but will not be constructed in large numbers in times of peace, as they are peculiarly adaptable to being produced quickly in large numbers after the emergency of war has arrived.

Although we must conclude that the present tendency is toward increased size and cost, one cannot overlook the fact that this very tendency, under the present financial, economic and political conditions in the world, may actually result in the long run in the disappearance from future building programs of these very types and the substitution for them of smaller and cheaper units made possible by new developments in science and engineering.

To meet this condition there never was more need than at the present time of vision and imagination on the part of the fighting forces afloat and the naval designers ashore, for that nation which can develop the weapons which will render obsolete the present great ships and can substitute for them a smaller and cheaper unit capable of defeating them will win in the new era the command of the seas, which this war has shown is so all important to ultimate victory.—*The Franklin Institute.*

THE INCREASED STRENGTH OF THE UNITED STATES ON THE SEA.—It has suddenly become apparent that our naval-building program has been steadily increasing the strength of our fleet of battleships, and that the United States Navy is at the point of surpassing the British Navy in this most important element of sea power. At the same time the British have realized the great increase of our merchant marine in comparison with Great Britain's.

These revelations have been something of a shock to the British public, and many articles have been published commenting on the growth of our navy and merchant marine. Among these is a notable contribution by Archibald Hurd in the *Fortnightly Review* for June.

For many reasons, a statement of the situation from an American point of view is needed at this time. In the first place, one prevailing tendency in the British comments should be set right. Many of their writers, as is perhaps natural in the surprised realization of the change in Great Britain's position on the sea, reflect a feeling that the forward stride of the United States indicates hostility on our part and a determination to win dominion of the seas. Comparisons are made with the systematic campaign undertaken by Germany to gain the commerce of the world, which had so much to do with bringing on the World War. Mr. Hurd even sees "a menace to the peace of the world, and especially the peace of the English-speaking peoples."

Many British writers now appear to believe that America has recently changed her attitude and become hostile to the nations of Europe. The position of the United States in delaying ratification of the Peace Treaty is interpreted as meaning that America has withdrawn from association with Europe, and that this is to be followed by a national policy of aggrandizement, "a demand for nationalization," as Mr. Hurd expresses it.

The True Explanation.—It is true that the present position of the United States on the sea was brought about by conditions created by the World War, but these were straight-forward natural conditions that made an appeal to the common sense of our people. We saw the need of a larger navy for defense, and we were also suddenly obliged to build a great tonnage of carrying ships in the emergency caused by the shortage of the world's shipping at the time of Germany's U-boat campaign. These were the reasons for our naval and maritime activities. There were no underlying motives that influenced the United States.

Our Naval Program.—The circumstances of the naval increase should first be explained; it will then be evident that our present program for building warships is not the product of any recent change of policy. Our increase was determined in 1916, through the most natural causes, as will be seen when the course of events is traced leading up to the adoption of our naval-building program.

The following is the history of our naval increase: In the period of dawning suspicion and hostility which preceded the World War there was a sudden keen competition for naval superiority between Great Britain and Germany. This began in 1906, and each nation entered upon an enlarged program of building battleships. This naval activity was stimulated by the unusual condition that the capital unit of battle fleets had changed in that year to a new type, following the British design of the dreadnought, which became the name of the new all-big-gun battleship.

The adoption of this new fighting unit gave Germany an unexpected opportunity to threaten the supremacy of the British Navy, a development that would have been out of the question if the two navies had kept on in

the even course of adding battleships of the old type. In 1907, Germany laid down four dreadnoughts, in 1908 four, in 1909-1910 five, in 1911 four. In these years Great Britain was perforce obliged to respond with a corresponding increase that would maintain the existing British superiority—and this pace was continued until the outbreak of the war.

In 1906, when this great increase of building warships began, the United States held second place among the navies of the world; but, through all these years of activity, until the catastrophe of 1914, our successive Administrations adhered to the policy of restricting the building program of the United States Navy to two capital ships per year. The inevitable result was to put our navy in the third place, far behind the German Navy in number of capital ships.

Then came the World War, and the United States woke to the fact that it was comparatively weak in the most essential element for its defense, a battle fleet. So evident was this, that public opinion asserted itself, and in 1916 Congress authorized the present building program.

Purely Defensive Move.—It should be strongly emphasized that this act of the people and Congress in 1916 fixed the terms of our building program, which is now suddenly causing so much comment in Great Britain. It involved no change or threat. Our program is only the result of a timely realization among our people that our necessary defense must be a strong navy. There was, at the time, no definite thought in the public mind of using this naval force against any particular nation, although naturally the unbridled ambitions of Germany showed our need of defense. But defense alone was the object of the increase—and defense alone is the reason for its continuance, impersonal and not directed against any power.*

This instinct for defense on the seas has been most fortunately aroused in our nation. Our country is bounded by two great oceans, and the only real defense of our boundaries is the far-flung use of our battle fleet upon these wide stretches of sea. For the United States Navy, more than for any other, the ultimate service is a battle of fleets. In all human calculation, our country is safe from attack as long as we maintain a battle fleet that is able to defend our sea approaches in a naval action.

Consequently, for the United States, a battle fleet that can hold its own in an action of fleets is a necessity—and the posession of such a fleet has been insured by the building program of 1916. That is the whole story—and in this wise policy, which our country adopted four years ago, there is no trace of new influences at work "for fanning into flame the instinctive national jealousies of the two nations"—to quote again from Mr. Hurd: Any American knows that our country is barren ground for jealousy of any other nation.—*Current History Magazine,* September, 1920.

OUR DIRIGIBLE "R-38".—We understand that the American crew to be trained in England to fly back our monster airship, the R-38, has been selected. We hear also from England that the ship will be ready to commence her exhaustive trials fairly soon. It takes a long while to tune up an airship—there are so many balances to be perfected, apart altogether from engine trials and the like. The following figures which have not been published in this country before will give a fair idea of the dimensions, of the R-38, in comparison with the R-34, which flew the double Atlantic journey last summer.

	R-34	R-38
Length (in feet)	639-5	695
Capacity (in cubic feet)	2,000,000	2,700,000
Tonnage	60-7	92-0
Maximum speed	58	70

* In fact, included in the act creating the building program of 1916 there is a provision for stopping construction, if this is made possible by an adequate tribunal for arbitration.

The German airship *Bodensee,* to which so much publicity has been given, is more than one hundred feet shorter than the R-38, has a gas capacity of only 700,000, and is of 21-3 tonnage. It is claimed, however, that her maximum speed is 80. Her main disadvantage is obviously her inability to travel great distances on account of her limited gasbag capacity.—*Scientific American,* Aug. 21, 1920.

THE RELATIVE POSITION OF BRITISH AND U. S. A. SHIPPING.—The figures issued by *Lloyds' Register* a week or so ago indicate a marked change in the position of the shipping in this country and the United States of America. One June 30th a year ago the latter had about one and one-third million tons of shipping under construction over that of this country, and in six months this disparity had been wiped out, and an excess credit of twenty-seven thousand tons created in favor of Great Britain. The returns for the present year show that over three million and a half are now under construction, which is nearly one million and a half in excess of that of the United States. To show the rate of reduction, in March, 1919, just over four millions was under construction, and now fifteen months later only about two millions is the figure—a reduction of one-half. Taking the figures for this country for the same period, in March we had two million and a quarter under construction, and now we have over three million and a half, which is an increase of sixty per cent. The reasons for this change are not far to seek. The United States was persuaded by the Allies to build ships at a rapid rate as one of the most useful steps to rendering assistance in the war, and right loyally did the statesmen, business men, and manual workers in America respond. We have recorded on more than one occasion the remarkable feats of production performed, and drew attention to the stimulating effect it had on us, and the depressing effect it had had on the enemy. After the Armistice the conditions due to the war practically ceased, involving the solution of a number of difficult problems. The most optimistic of those in the United States who had long cherished ambitions with regard to the development of a Mercantile Marine on a vastly extended scale, and saw the possible opportunity when the States entered the war, recognized, on the cessation of hostilities that a number of the newly organized shipyards could not survive the new conditions. For example, a large number of yards were devoted to the building of wooden ships, and in June, 1919, four hundred and twenty thousand tons of such ships were then building, while in June this year that enormous tonnage has shrunk to twenty-nine thousand, which is about one-fifteenth the previous year's output. The United Kingdom, on the other hand, had a large number of yards engaged on warship construction, and it was more or less easy to turn the activity of the yards towards the production of mercantile tonnage. Another point that must not be lost sight of, which is, assuming a nation can produce ships, it does not follow it can man them. It will, therefore, be seen that not only could the conditions of production be rapidly changed over in this country, but we had another great advantage. For centuries, a very considerable proportion of the inhabitants of the United Kingdom have found employment at sea, and the in-born liking for the sea enables ships to be manned by those who have inherited the necessary qualifications for such service. Under these conditions we can afford to run a Mercantile Marine on a profit basis, whereas other countries find they cannot do it at all, or if they do, it is at a loss. It seems fairly evident that, however strongly some of the United States citizens desire a large Mercantile Marine, this cannot be brought about unless the national energy now being utilized so successfully in its vast and bountiful interior, and in such a profitable manner, can be diverted into other channels, which, under all the circumstances, will not happen while present conditions obtain.—*The Marine Engineer and Naval Architect,* August, 1920.

WORLD'S STEAM TONNAGE.—According to the 1920-21 edition of *Lloyd's Register of Shipping*, the world's steam tonnage amounted to 53,905,000 tons in June last. The following table shows the changes in the steam tonnage of the leading maritime nations between June, 1914, and June, 1920:

Country	June, 1920 tons gross	June, 1914 tons gross	Differences between 1920–1914 tonnage
United Kingdom	18,111,000	18,892,000	— 781,000
British Dominions	2,032,000	1,632,000	+ 400,000
America (United States)—			
Seagoing	12,406,000	2,027,000	+10,379,000
Great Lakes	2,119,000	2,260,000	— 141,000
Austria-Hungary	Nil.	1,052,000	—
Denmark	719,000	770,000	— 51,000
France	2,963,000	1,922,000	+ 1,041,000
Germany	419,000	5,135,000	— 4,716,000
Greece	497,000	821,000	— 324,000
Holland	1,773,000	1,472,000	+ 301,000
Italy	2,118,000	1,420,000	+ 688,000
Japan	2,996,000	1,708,000	+ 1,288,000
Norway	1,980,000	1,957,000	+ 23,000
Spain	937,000	884,000	+ 53,000
Sweden	996,000	1,015,000	— 19,000
Total abroad	35,794,000	26,512,000	+ 9,282,000
World's total	53,905,000	45,404,000	+ 8,501,000

Syren and Shipping has compiled the following table showing the comparative positions of the leading maritime countries in 1914 and in 1920:

	1914	1920
1	Great Britain	Great Britain
2	Germany	U. S. A.
3	U. S. A.	Japan
4	Norway	France
5	France	Italy
6	Japan	Norway
7	Holland	Holland
8	Italy	Sweden
9	Austria-Hungary	Spain
10	Sweden	Greece
11	Spain	Brazil
12	Greece	Germany

—*The Nautical Gazette*, Aug. 14, 1920.

FIGHTING FOR OUR PLACE ON THE SEAS.—The opening gun of a world-wide shipping war is discerned by the *Brooklyn Eagle* in the recent offer of British ship-builders to construct steel vessels for a hundred dollars a ton less than the cost-price at which the Shipping Board is offering its ships for sale; and other papers remark that a retaliatory spirit in government and shipping circles of Japan, England, and France first manifested itself to the press of the United States soon after the enactment of the Jones Merchant Marine Act law last June. Particularly did the preferential rate clauses, which were discussed in *The Literary Digest* for July 3d, arrest the attention of foreign shipping interests, for these, according to Senator Jones, would assure to America "her rightful place on the seas." Admiral Benson, the new chairman of the Shipping Board, announces that the Board "will live up to the letter of the Jones law in spite of the

threats and propaganda carried on by foreign interests to seek to defeat the purpose of the law." He frankly resents "the secret and underhand means that are being taken to hamper the growth of our merchant marine and the development of our foreign trade"; and he declares, with emphasis, that "we shall maintain and protect our merchant marine and foster American commerce in American bottoms against any and all nations." So "all this 'bunk' is not going to scare the admiral; fighting used to be his business," says R. H. Semmes in the *Seattle Times.*

Another development which has caused freight-rate slashing, we are told, is the twenty-year agreement entered into by the American Ship and Commerce Corporation with the Hamburg-American Line, whereby a joint service "will be established to various parts of the world, and a close working agreement entered into for the mutual benefit of the two corporations," in the words of the *Washington Post.* This despite the fact that "we are technically at war with Germany," points out *The Post.* In the meantime Japan has decided to subsidize its shipping business to the extent of two million dollars, we are told, and "Britain and Germany are trading with each other almost as if there had never been a misunderstanding," declares the *Rochester Democrat-Chronicle.* So that at the present time, thinks the *New Orleans Times-Picayune,* "unfair discrimination would be a short-sighted policy to launch out on in the development of a permanent foreign commerce or a stable, adequate merchant marine." Foreign shipping interests declare that the Jones law does discriminate. And even in this country we find conflicting opinions as to just what sort of panacea for shipping the Jones law is. Admiral Benson and Senator Jones both agree that this country is faced by the question of the survival of American ships or foreign ships, and that the Jones law will protect the merchant marine which we acquired during the war. As J. J. Underwood writes in the *Seattle Times:*

"There is still much discussion in Washington about the Jones law, and the remarkable thing about it is that American ports fear they will lose foreign ships and foreign ports fear they will lose American business. But there are no two opinions about it among Shipping Board officials. They say that the only condition that can possibly be changed by the law is the substitution of American ships for foreign ships, and that if the change is made the advantage will lie with the American ship-yards, ship-chandlers, and those who deal in merchandise that American ships consume.

"They declare that American ships have had to leave foreign ports for the United States cargo-light, while British and Japanese ships plying between foreign countries and the United States have come loaded to the guards with cargo. American ships also have had trouble in getting water and fuel, while foreign ships have been accommodated. Already the word has gone forth that this discrimination against American ships must cease or the provisions of the Jones law will be made effective against those companies which practice it."

So the shipping war goes merrily on. The *Cincinnati Post* declares that the Jones law, far from benefiting the American people, "contains the trickiest little joker that ever snuggled in a mess of legislation—a combination of ship subsidy and protective tariff that will cost the United States the commercial friendship of all other nations." Furthermore, asserts *The Post,* this "joker" "will give fortunes to the owners of ships and cost the people hundreds of millions of dollars every year." But the *Minneapolis Tribune* has a different idea of the things which the Jones law will accomplish:

"The Merchant Marine Act is designed to make use of and to develop the merchant marine structure erected for war-emergency purposes. It lays down explicitly a 'policy of the United States to do whatever may be necessary to develop and encourage the maintenance of such a merchant marine.' This is a sweeping way to put it, but a policy of sweeping

character was adopted deliberately. To carry out the provisions of the bill, it will be necessary to abrogate or modify more than a score of commercial treaties with other nations. There is no halting anywhere along the line at preferential rates and terms that may be needed to make and keep the merchant marine a going concern against all comers and all competition.

"In the broadest sense the act is American in spirit, purpose, and term. It includes government encouragement, supervision, and protection, but it does not contemplate government ownership or operation. It serves notice upon the world that henceforth the United States will put its own interests foremost in its shipping laws and rules."

According to *Lloyd's Register*, of London, the gross tonnage of United States shipping has increased since 1914 until in this respect we are second only to the United Kingdom. In other words, the United States has twenty-four per cent of the world's shipping. Thus did the war provide our merchant marine. Next in order come France, Japan, and Norway. But, the *St. Louis Globe-Democrat* points out,

"The goal of our merchant-marine plan is not to secure a tonnage greater than Great Britain, and thus to become the greatest maritime nation in the world. Our object is to provide ships for American commerce, enough ships to carry all our exports and imports if possible, certainly enough to promote our export trade and relieve it of the handicap of relying upon foreign bottoms for carriage."

The *New York World's* Washington correspondent reports "an alliance of British, Japanese, and other foreign shipping interests with the view of crushing the American merchant marine, in retaliation for what is considered discriminatory provisions in the Jones law. The *Washington Star*, however, takes such a procedure as a matter of course. "We may expect vigorous competition as we go along; that is business on the water as well as on land," notes *The Star*, and its Washington contemporary, *The Herald*, admits that the act "cannot be enforced without provoking defensive and retaliatory action." The *Oakland Tribune* merely remarks that "all of these manifestations are England's disappointed and frightened outcry against America's program for achieving and maintaining independence of American maritime trade." But, points out the *New York Journal of Commerce:*

"The discriminatory sections of the law are not intended as a 'club' for use against foreign competitors, but are merely a means of compelling them to 'play fair.' It should be recognized by every one who desires the establishment of an American merchant marine that there has been gross discrimination abroad against American interests and that the 'shipping game' has been anything but fairly played by many of the foreign pools, combinations, and 'conferences.' Whether it will be possible to correct these abuses by introducing similar discriminations in the United States is, however, a very different question."—*The Literary Digest*, Sept. 4, 1920.

AERONAUTICS

PHOTOGRAPHING HAITI'S COAST LINE WITH AIRPLANES.—The present strength of the Marine Corps aviation force in Haiti is ten officers and 99 enlisted men, and the organization, Squadron E, is engaged with Squadron D, of Santo Domingo, comprising eight officers and 84 men, in making a photographic survey of the entire coast line of the island of Haiti, under the direction of the interior department of the U. S. Military Government of the island. Several officers who have completed the course in aviation at the Quantico Marine Air Station will be sent to Haiti at an early date to assist in this work.—*Aerial Age Weekly*, Aug. 16, 1920.

AEROPLANE TURRET TAKE-OFFS SUCCESSFUL.—The first flight of the new Vought aeroplane under test for the U. S. Navy from the turret platform

that the *U. S. S. Oklahoma* was successfully accomplished August 11th, and the following day four faultless take-offs were made from the turret, completing the test. The aeroplane acted satisfactorily on each trial, according to reports to the Navy Department.—*Aerial Age Weekly,* Aug. 16, 1920.

NAVY SMOKE SCREENS FROM AIR BOMBS.—Tests conducted by representatives of the Bureau of Ordnance, Navy Department, with smoke bombs designed to lay a smoke screen for naval vessels from aircraft, proved that a satisfactory screen can be laid in this manner. Experimental models of smoke bombs weighing 50 pounds were tested on August 11th, but after the experiments it was agreed that a bomb weighing not less than 100 pounds would prove to be more satisfactory for the purpose for which the experimental models had been designed.—*Aerial Age Weekly,* Aug. 16, 1920.

NAVAL FLIGHT FROM SAN DIEGO TO PANAMA.—Eighteen seaplanes of the *F-5-L* type and two of the noted *NC's,* Nos. 5 and 6, are to take part in a 3600-mile flight from San Diego, Cal., to Panama, beginning about Jan. 1, 1921. The plans for the voyage specify that 12 of the *F-5-L* design ships will be supplied by the Pacific Fleet detachment and six by the station at San Diego. The crews have not yet been selected. Air officials of the San Diego station are quoted as saying that the flight, the course of which will be down the Mexican and Central American coasts to the Isthmus, will probably be made in about sixty hours.—*Aerial Age Weekly,* Aug. 16, 1920.

NC SEAPLANES FOR FLEET OPERATIONS.—Five of the large *NC* seaplanes have been assigned to operate with the U. S. Navy fleets, three on the Atlantic and three on the Pacific. These seaplanes, carrying crews of five men each, will be employed on scouting problems and long-distance work, for which they are well adapted, being fitted for navigation on the surface and with the radio direction compass. The definite program for their employment is being worked out by the Fleet Air Detachment commanders, Captain George W. Steele, Jr., U. S. N., of the U. S. Atlantic fleet, and Captain H. C. Mustin, U. S. N., of the U. S. Pacific fleet. The *NC* seaplanes will have destroyer tenders for these operations. This is the first time seaplanes of this type have been thus employed and the work will begin before September 1.—*Aerial Age Weekly,* Aug. 16, 1920.

AMERICANS IN DIRIGIBLE FLIGHT OVER LONDON.—*London.*—The British dirigible airship *R-32* flew over London in the commencement of a twenty-four hours' instructional flight.

The airship carried the American crew which is training in England to take over the dirigible *R-38,* which has been purchased by the U. S. Navy and is under construction at Bedford.—*Aerial Age Weekly,* Aug. 16, 1920.

AIR TANKS.—July 15.—Ten armored triplanes will be built for the United States Government under a contract awarded to the Boeing Airplane Company of Seattle, construction starting at once with the first delivery scheduled in November and the other machines following rapidly before the end of the year. These planes, representing a new type of construction, are designed to serve in aerial service for ground attack, having a function similar to that of the tanks on land. They have been characterized as "flying tanks." Quarter inch armor plate protects the fuselage and nacelles. The armament includes a thirty-seven millimeter rapid fire gun mounted in front, four machine guns trained to fire through the floor, two machine guns at the back and two above the wings.—*Flying,* September, 1920.

GREAT LAKES HAS LARGE AVIATION SCHOOL.—Nearly 100 men are being graduated every three weeks at Great Lakes Naval Training Station from what naval officers describe as the biggest trade school in the world.

The school is devoted exclusively to the training of aviation mechanics and at the present time 3225 students are taking the courses, which range in length from 16 to 36 weeks.

More than 1000 men have graduated since the school was established slightly more than a year ago and another 1000 will complete their work by November. Lieut. Commander E. E. Wilson, commandant at the school, says all of the 6000 men provided for in the naval air force will be graduates of the school within another year.

The cost of turning out the first 1000 graduates was $7000, making the average cost of producing trained aerial mechanics $7 each. The low cost was due to the fact that the students produce nothing in their studies to be wasted. Instead of making the frequently useless examples they work on parts actually needed for repairs and construction of new aeroplanes.

A number of planes ranging from small land flyers to huge seaplanes, only a step smaller than the famous *NC* type, have been completed.

Lieut. Commander Wilson started the school from the bottom a year ago. As the first step the navy officer wrote all the text books to be used.

No flying is done but the best men from each class are eligible later to attend a school for enlisted pilots. The 3225 students now here include 440 marines.—*Aerial Age Weekly*, Aug. 8, 1920.

ENGINEERING

THE ELECTRICALLY-WELDED SHIP "FULLAGAR."—The motor coasting vessel *Fullagar*, which has recently been completed by Messrs, Cammell, Laird & Co., Ltd., Birkenhead, is noteworthy both on account of the employment of electric welding in her hull construction, and because she is the first vessel to be fitted with the Cammellaird-Fullagar type of marine oil engine.

The leading particulars of the ship are:

Length B. P.	150 ft. 0 in.
Breadth moulded	23 ft. 9 in.
Depth moulded to main deck	11 ft. 6 in.
Depth moulded to raised quarter-deck	15 ft. 6 in.
Load draft	11 ft. 4 in.
Load deadweight, about	500 tons
Cargo capacity, about	25,000 c. ft.
Speed	9½ knots

In general arrangement the vessel is of the ordinary coasting type.

The electric welding has been carried out on the "Quasi-Arc" system, introduced by the Quasi-Arc Co., Ltd., of London, who have carefully supervised all welding operations, as have also the representatives of *Lloyd's Register* of Shipping, with which society the vessel is classed.

The main engine is of the Cammellaid-Fullagar opposed-piston type, and is capable of developing about 500 B. H. P. when running at 100 to 120 revs. per minute. The engine has four cylinders 14-inch diameter, each piston having a stroke of 20 inch, and working on the Diesel cycle. Air at a pressure of 1000 lbs. per square inch is used for injecting the fuel into the cylinders. A three-stage air compressor is driven from the forward end of the crankshaft, and the circulating pumps are arranged forward of this again, thus rendering the engine a self-contained propelling unit. The saving in weight and space effected by this type of engine is considerable.

On the 28th June trials of the vessel were carried out in the River Mersey, in the presence of a large number of engineers and shipbuilders from all parts of the country. The ease and quickness with which the engine could be maneuvered impressed all present. Front full speed ahead to full speed astern only required about ten seconds, the engine easily starting action with full ahead way on the ship.

At about 11-40 p. m. on the same day the vessel started on her maiden trip to the Clyde. After getting clear of land extremely rough weather was encountered; and as this became worse, it was found necessary to put into Ramsey until the storm abated. During this part of the voyage the engine ran steadily throughout, no racing being experienced, and there was only a slight variation in the revolutions. The hull was well tested, and withstood perfectly the severe shocks and stresses experienced through the force of the waves.

The vessel left Ramsey at 4.20 a. m. on the 1st July, and reached Greenock about 6 p. m. The engine continued to run steadily at a speed of 106 r. p. m., the ship doing about 9.75 knots per hour against wind and tide.

On the 2d July, a large party of Clyde ship-builders and engineers were present and witnessed trial runs on the mile and maneuvering tests. All expressed satisfaction at the running of the engine and the promptitude and satisfactory manner in which orders from the bridge were executed.

The *Fullagar* left the Clyde at 11.30 p. m. the same day, and arrived in the Mersey at 8 p. m. on the 3d July. The engine ran satisfactorily and without sign of trouble at an average speed of 107 r. p. m., the vessel averaging about ten knots. During this run the fuel consumption worked out at 2.1 tons per day of 4 hours.

Some of the readings from the engine were as follow:

Scavenge air pressure	1¼ lb. per sq. in.
Circulating water pressure	6.5 lb. per sq. in.
Lubricating oil pressure	12 lb. per sq. in.
Blast air pressure	1,000 lb. per sq. in.
Scavenge	50° F.
Circulating discharge temperature	100° F.
Engine-room temperature	62° F.

—*The Shipbuilder*, August, 1920.

CONCRETE SHIPBUILDING.—It can be stated with fair certainty that reinforced concrete will not replace steel for ordinary cargo carriers unless the hull can be built for considerably less than half the cost of building the same hull in steel.

Where the additional weight is more than counter-balanced by the durability and reduced prime cost of the new material there is reason to expect that its adoption will naturally follow. The lower first cost of concrete vessels is partly due to the fact that no heavy plant is required for reinforced concrete work, partly due to the relatively lower cost of the reinforcement, as compared with other forms of steel and partly to the lower rates of wages paid to the men employed. The saving in the cost of steel seldom exceeds 50 per cent. On an average the cost of a concrete hull is about 70 per cent of that of a steel hull of the same dead-weight capacity.

In the case of pontoons the cost of construction (prior to 1914 was found to be about one-half, and the cost of maintenance and repairs only one-quarter to one-third that of similar structures in steel. (A. B. Searle, *Concrete and Constructional Engineering*, July, 1920.)—*The Technical Review*, August 17, 1920.

THE MOST POWERFUL GAS ENGINE IN THE WORLD. (*La Nature*, June 19, 1920.)—This distinction is claimed for an engine made by the Crockerill Society in Liege, Belgium. In August, 1914, it was in process of erection. The Germans after the capture of the city allowed it to be put into operation and, when they were assured of its success, took it from its owners and sent it into Germany, to Duisburg, where it was running at the time of the Armistice. It was then sent back to Liege, where it was installed for the second time, with the addition of some improvements. It develops 8000 horsepower. The cylinders, four in number, are 1.3 m. in diameter, 1.5 m.

stroke, 94 r. p. m. The heat of the gases coming from the engine is used to generate steam for a turbine.—*The Franklin Institute*, August, 1920.

NEW BETHLEHEM FUEL-SAVING DIESEL ENGINE.—Once more Charles M. Schwab appears in print with a statment of vital interest to ship operators. This time it is an announcement of a new type of Diesel engine representing, says Mr. Schwab, a greater advance over the oil-fired steamer than the latter represents over the coal-fired vessel.

Mr. Schwab's statment reads as follows:

"It is a great pleasure for me to announce a new two-cycle fuel-saving marine Diesel engine especially designed for American operating conditions and adapted to land use as well as cargo vessels of any size. In the science and practice of marine engineering this new engine represents a far greater advance over the oil-burning steamship than the latter is over the coal-fired steamship. It is also regarded as a signal triumph for American engineering skill in a field hitherto dominated entirely by Europeans.

"The development of the new Bethlehem fuel-saving Diesel engine represents two distinct phases of advance in marine engineering:

"1. For the first time an internal combustion heavy oil engine for either marine or land uses has been perfected which is not only designed and built by Americans, but is built especially for Americans, and is adapted to American operating conditions.

"2. For the first time a two-cycle internal combustion heavy oil engine has been perfected which produces the same horse-power as a four-cycle engine practically twice its size, and is at the same time adapted to large cargo ships while saving two-thirds in fuel cost alone, as compared with steam-driven, oil-fired vessels.

"Neither of these developments is theoretically a new idea. For years Europeans have successfully operated large ships with Diesel engines. The achievement of Arthur West, the Bethlehem designer, who is at the head of our power department, is in the adaptation of the two-cycle engine to American operation and in the perfection for practical use in cargo vessels of any size.

"The success of this engine has already been demonstrated in two ways. It was installed and operated for ten months as part of the power plant of the Bethlehem Steel Corporation at Bethlehem, Pa. It was then installed in our new ore-carrying vessel, the *Cubore*, which to-day completed on regular schedule time its first voyage to Cuba and return.

"The operation of the engine at the Bethlehem plant was so successful that we are building another one to take its place as part of the auxiliary power plant for the steel mills. Its operation on the *Cubore* not only demmonstrated its practicability but its remarkable economy. The *Cubore* made the voyage from Sparrows Point, Md., to Cuba and back without stopping her engines except to come into port and consumed one-third of the amount of fuel oil ordinarily used by her sister vessels fitted with oil-burning steam machinery of the usual type when running on this same voyage and at a much greater rate of economy than has been achieved by any other Diesel engine operated ship of which we may have any record.

"We also have in service between here and Cuba duplicate ships, except that some are fitted with turbine reduction gears and some with reciprocating engines so that we have a direct comparison between the oil engine installation and the most modern steam installation."—*The Nautical Gazette*, Sept. 2, 1920.

ORDNANCE

NEW LIGHT ON THE JUTLAND BATTLE.—Many and varied have been the theories advanced to account for the practical immunity enjoyed by the German High Seas fleet in the Jutland action. The attempts to reconcile our undoubted victory with our heavy material losses have, in many cases, been very wide of the mark. A careful study of the official documents on

both sides, bearing in mind the actual state of affairs with regard to the personnel and material of both the British and enemy fleets reveals the fact that the elements which contributed to our losses have, to a large extent, been overlooked by the critics.

Our heaviest losses occurred in the battle-cruiser action between Beatty and von Hipper's squadron, before either of the main fleets joined in the fight. Our forces were, on paper, immeasurably superior to the German, and it was not long before our ships of the *Warspite* class came to their support. Thus we had 32 15-inch guns and 32 13.5-inch guns in action at this phase of the battle, whilst the heaviest piece mounted in any of the enemy vessels was the 12-inch. Yet we lost the *Queen Mary* and the *Indefatigable*, the former one of our finest battle-cruisers, right at the outset, whilst the Germans only lost one modern capital ship, the *Lutzow*, during the entire course of the battle.

Going into the matter more closely, it will be found that the German ships received a most terrific hammering, however, and that the majority of the British craft came through a series of sanguinarily contested actions almost scathless. Our guns were better, our shooting was probably better, and our morale was certainly far better than that of the enemy. Yet, at a later stage of the action, we lost another battle-cruiser, the *Invincible*. In face of these facts, it is no wonder that such difficulty has been experienced in accounting for the heavy losses on the British side. Viscount Jellicoe has been blamed on account of imagined weakness in both strategy and tactics and has generally been made the scapegoat for failures and shortcomings over which he could nowise have had any control.

Whitehall was entirely to blame for both our failure to inflict more heavy damage on the German High Seas fleet and for our own losses. With our splendid secret service and our very efficient gunnery experts, there was no excuse at all for the blunder made in the designing of our ships of the line and for the failure to fit them to attack and to resist attacks of the only fleet they would have to encounter. For that was the cause of the *Queen Mary* and *Indefatigable* disasters and the reason why the *Lutzow* was the only German capital ship to be sunk. Ship for ship, on paper, the British seemed to be superior, and their numerical advantage in the battle overwhelming. Actually, the Germans were so superior that the greatest numbers of Jellicoe's fleet was more or less nullified and by withdrawing at the right moment, von Scheer was able to avoid the real defeat which Britain expected the Grand fleet to inflict upon him.

All our naval artillery had been designed with a very high velocity, consequently with a long range at a small angle of elevation and a correspondingly large danger space. To combat this, German capital ships had been provided with very stout vertical armor. In addition, they had a more minute internal sub-division, a better disposition of their magazines, and thick horizontal deck armor, funnel glacis and turret roofs to afford protection from our heavy shells, descending at steeper angles at the long ranges at which it was anticipated the British guns would be brought into action.

On the other hand, the German theory differed widely from our own. Their guns were lighter and shorter, and their velocity was lower. But their mountings were designed to give a very great angle of elevation and their effective range was as great as that of our heavier pieces. In order to obtain accuracy at these long ranges, they had developed range-finding and fire control to an extent which was never realized in this country until hostilities had ceased. Their guns were of an accuracy that was deemed impossible for a "built-up" weapon and they calibrated them so as to give no spread or a salvo.

These facts were known at the Admiralty before the war started and we had ample proof of them in the early actions. Yet the *Hood* was the first, and is still the sole ship, flying the White Ensign to embody in her design an effective form of defence against these tactics. Our ships had a

minimum of horizontal protection and our range-finding was of an order that made shooting at anything like the extreme range of our guns very much a matter of chance.

In the *Hood,* many of the features of the German battle-cruisers interned at Scapa Flow in 1918 have been embodied. She embodies ideas of protection against a "plunging" fire, and is sub-divided and strengthened very much as was the *Hindenburg.* The peculiar thing about it is that every naval power but Germany copied us in adopting high velocity guns. And now we have mounted our armament on their lines, so as to give a big angle of descent to the projectile at the target end, as have the Americans in their newest battleships. The numerous long-base range-finders in the *Hood* were in use in the German fleet before the Jutland battle.

The German policy of ship design and their artillery scheme were both thoroughly vindicated in the Battle of Jutland, just as the British were shown to be faulty. Strategically and morally von Scheer was badly beaten off the Horn Reef on the fateful 31st of May, four years ago. Officers and men on both sides performed epic deeds of gallantry. But since then we have had time to find out just how our "expert" advisers had muddled and bungled and how they had "let down" those gallant men who fought the stern fight in the watery wastes of the North Sea.—*Marine Engineer and Naval Architect,* August, 1920.

THE ERRORS OF MEASUREMENT IN RANGE-FINDERS.—The usual expression for the error of measurement in the case of a range-finder is: $f = \pm e^2/b.v.20{,}000$ where e is the measured distance, b the length of base, and v the magnification of the instrument.

For the accuracy of vision an angular value of 1/20000, corresponding to about 10 seconds, is fixed upon. The value of f given by the above formula is known as the "minimum error"; in practice a value equal to four times this minimum error is introduced and known as the "allowable error." The accuracy of range-finding depends, however, on other factors than the ones just mentioned. The form of the object, the weather, the type of setting, and the personal equation of the observer are some of the things that affect the accuracy of measurement. Taking these things into account, the author develops the formula

$$f = \pm k(1 - \alpha^{-e})(e^2/b \cdot v) \cdot \delta$$

where k is a factor depending on the type of instrument, α is an absorption coefficient taking account of the weather, and δ is a factor which includes the effect of personal error and the change in the physiological limiting angle caused by the constitution of the object; in the best cases δ falls to the value of 10 seconds. If the object is in motion an additional factor $(1 + \lambda\omega^2)$ is introduced into the formula, where ω is the regular velocity of the object in the direction of the line of division in the field of view of the range-finder, and λ is a constant which depends on the kind of instrument and on the dexterity of the observer. The value of 10 seconds, which from experience has been assumed to be the value of the accuracy of vision, cannot be considered as constant. From a consideration of the effect on the retinal rods and cones it is to be expected that the longer the object is (within certain limits), the greater the accuracy of setting should be, owing to the fact that a greater number of retinal elements are brought into action.

In order to test the effects of size and form of the object a number of experiments were carried out. Two black rectangles of variable height and of breadth 50 mm. were set up on a white background. They could be moved sideways relative to each other distances of from 1 to 5 mm. If observed with the unaided eye at a distance of 20 meters a displacement of 1 mm. would correspond to the physiological limiting angle of 10 secs. In order to prevent the measurements from being influenced by the observer's other eye, binoculars having magnifying powers of six and eight

were employed at distances of 120 and 160 meters respectively from the object, one of the objectives being in each case covered. In this way errors due to accommodation were eliminated. For each set of measurements at least 50 trained observers were employed. The percentage number of correct estimations, corresponding to various heights and relative displacements of the rectangles are given in Table I.

TABLE I. TABLE IA.

Observation with 6 × binocular at distance 120 meters.
Breadth of rectangle 50 mm.

Height in mm.	10	20	30	40	10	20	30	40
Displacement 1 mm.	25	31	34	29	.22	.28	.31	.26
" 2 "	35	50	56	55	.16	.24	.27	.27
" 3 "	25	57	72	77	.07	.19	.22	.17
" 4 "	28	63	78	82	.06	.09	.17	.24
" 5 "	35	68	87	82	.06	.14	.21	.19

It follows that, at least for the larger displacements, there is an increase in the certainty of observation with increase in height of the object.

When an observer endeavors to set for coincidence, as in range-finding, the errors of observation will in magnitude and distribution follow the laws of probability. The probability 0.5 will then correspond to the limit of the region of certainty, and therefore to the magnitude of the "minimum error." Now, for a given displacement s the probability that a setting will be within the region of the displacement is given by

$$W = \frac{2h}{\sqrt{\pi}} \int_0^s e^{-h^2x^2}\,dx$$

where h denotes the coefficiency of accuracy. The same formula holds for the probability that a large number of observers, for a given relative displacement of the rectangles, will estimate the displacement correctly. Table Ia gives the values of h calculated by means of the probability formula from the results of Table I. It can be seen that for a constant value of the ratio of height to displacement the value of h is constant and that with increase in this ratio h increases up to a more or less constant value. In the case of the rectangles of breadth 50 mm. the physiological limiting angle was found to be about 20 seconds, whereas with rectangles of breadth 10 mm. the value was about 14 seconds, which is in good agreement with Wulfing's result, namely, 12 seconds.

Observations were also made with objects in the form of gratings and with black rectangles having white lines down the middle. In the latter case it was found that for low values of the height the accuracy was less with the white center lines than without, whereas it was greater for heights of 60 mm. or more. Further observations showed that the accuracy of setting increases, the more nearly the partial objects are normal to the line of division. It was also found that the triple field type of setting (central strip) does not greatly increase the accuracy over that obtainable with the double field type.

The author develops empirical formulae connecting the coefficient of accuracy with the height of the partial objects and their relative displacement and the conclusion reached by the author is that with the usual forms of objects the "minimum error" may be taken as 10 seconds, but with partial objects inclined towards one another at an angle of 45° the error increases to 13 seconds. (Dr. Hans Schulz, *Zeitschrift für Instrumentenkunde*, Mar., Apr., Aug., 1919.)—*The Technical Review,* Aug. 3, 1920.

THE PRESSURE DISTRIBUTION ON THE HEAD OF A SHELL MOVING AT HIGH VELOCITIES. (L. Bairstow, R. H. Fowler, and D. R. Hartree. *Proceedings of the Royal Society*, A 684, May 1, 1920.)—The problem proposed to themselves by the investigators was one of great difficulty. Any kind of registering pressure-gauge placed within the shell would need to be insensible to a spin of 11,660 r. p. m. and to the shock of landing. This difficulty was avoided by employing a service time-fuse as a manometer. The rate of burning of such a fuse depends on the total external pressure on the vents. In the fuse a train of gunpowder is ignited by a detonator pellet by the shock when the gun is discharged. The time of burning is taken as the interval from the discharge of the gun to the explosion of the shell.

In the experiments shells were fitted with caps enclosing the fuses. In each cap was a series of holes equidistant from the nose of the shell. The relation between rate of burning and pressure was obtained from a set of experiments made with a fuse body mounted on the shaft of a Laval turbine and run in an air-tight box in which the pressure could be varied.

A series of shells provided with caps pierced with holes was fired along the same trajectory at brief intervals and the time of burning of the fuses was noted. From this and the length of the fuse the rate of burning was deduced and in turn from the rate of burning the pressure was derived at the part of the shell where the holes were located. This last step was made by reference to the laboratory experiments under varied pressure. "At all speeds in the range covered the pressure has a maximum positive value at the nose of the shell. The pressure falls rapidly as the point of observation moves toward the base, and is negative some distance before the cylindrical part of the shell is reached."—*The Franklin Institute*, August, 1920.

NAVIGATION AND RADIO

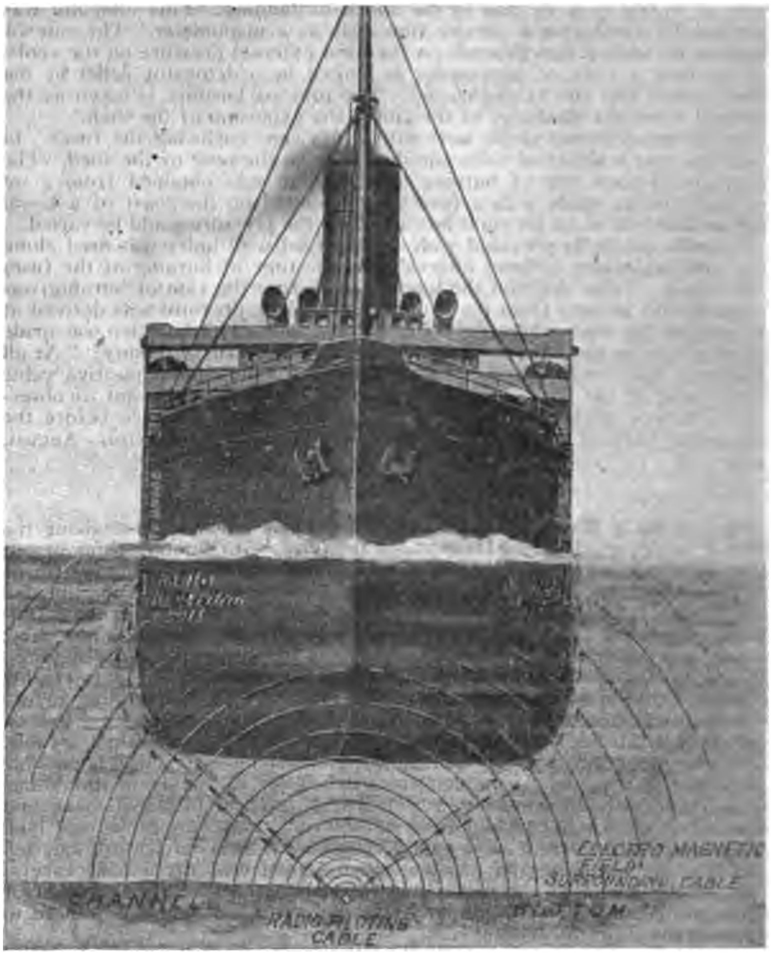
NEW YORK'S RADIO PILOT CABLE.—Much has been written about the electric cables used during the war for the purpose of piloting ships in and out of harbors at night. Indeed, it now appears as though this system of navigation is one of the greatest benefits derived from the war, and one that is just as important in peacetime as in war. However, with the installation of such a system in New York harbor by the United States navy, it is now possible to give exact details of how the radio pilot cable operates.

In brief, the principle of the radio pilot cable, as it is called, is to employ a cable through which flows alternating current. Ships intending to use the cable while passing in or out of waterways are provided with a pair of coils which intercept the electromagnetic waves emanating from the cable. By noting the relative strength of the waves reaching each coil, it is possible for the ship's navigator to determine when he is astride of the cable. Once riding astride the cable, it is relatively easy to follow it along and thus steer a correct course. In certain installations two cables are laid, each carrying a current of a given frequency. Ship navigators can tell which is the incoming and which is the outgoing cable by making careful note of the sound of the waves. In this manner a route is provided for ships going in either direction, and the chances of collision are reduced to a minimum.

In the New York harbor installation, which will follow the Ambrose Channel, one type of cable has been specified. This cable consists of seven strands of No. 16 tinned copper wire insulated with a layer of 30 per cent Para rubber 3/16-inch thick, over which is wrapped a layer of tape and jute, impregnated with a water-proof insulating compound. Over this layer of jute is an armor which consists of a wrapping of No. 12 galvanized steel wire. The overall diameter of this cable is approximately one inch. Some 87,000 feet of cable will be required.

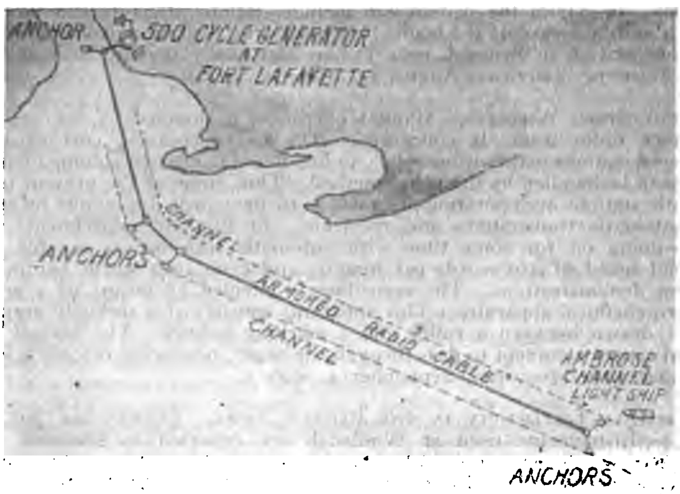
There will be two anchors secured to the extreme end of the cable and only one anchor will be used at each of the three other points along the cable.

A one-killowatt motor-generator will be used for supplying 500-cycle alternating current to the cable. The voltage may be either 125 or 250 volts. Provision will have to be made for driving this generator from local source of current supply so as to maintain the motor-generator set at a



constant speed. It is obvious that a fluctuation in the speed of the generator results in a change of note, which is apt to cause much confusion when using the cable. The amount of current flowing in the cable will be under control at all times and will range from one to eight amperes. A telegraph key is to be installed for the purpose of breaking the cable current in order to transmit signals; in fact, an automatic sending apparatus may be installed so as to send out given signals over and over again when necessary.

So much for the cable. Now the receiving end aboard ship is quite as simple. Two coils are required, each four feet square and wound with 400 turns of No. 24 S. C. C. copper magnet wire. Care should be exercised in making these coils so that each coil will have the same resistance and inductance values. Much depends upon this precaution as the signal strength received by each coil is the function of the resistance of each coil, and should their resistance be different, a signal strength of different intensity will be received by each coil when at the same distance from the cable. The best shape for the coils is the pancake. The wire can be wound in pancake form four feet square, with a winding space of one inch. The coils are impregnated in paraffin and then placed in wooden boxes with more paraffin in order to protect them from abrasion.



The coils should be placed over the side of the ship approximately amidship, one coil on one side and the other coil on the opposite side, below the surface of the water or slightly above the water line.—*The Scientific American,* Aug. 28, 1920.

THE LARGEST WIRELESS STATION IN THE WORLD.—The Radio-Corporation of America has purchased 6000 acres near Port Jefferson (Long Island) for the erection of what will be the largest wireless plant in the world.

Seventy-two towers will be employed, and it is said that the Alexanderson high frequency alternator system is to be used with multiple antennæ. This system requires relatively small generating plants and towers only about 400 feet high. The report states that communication will be established with South America, Germany, France, Italy, and Poland, and that each unit will have a speed of 100 words per minute, thus permitting a total transmission of 500 words per minute with simultaneous reception at the same rate. According to an official statement by the company this report is premature. (*Electrical World,* May 22, 1920. ½ col.)—*The Technical Review,* August 3, 1920.

FRANCE'S WIRELESS PLANS.—A dispatch from Paris states that the French Government has recently announced plans for an elaborate wireless system whose center will be in Paris and which will cover Europe, Asia, Africa and South America and connect with North America. If this system, part of which is already in existence, is integrally applied as now proposed, France's wireless communications throughout the world will be able to rival with Great Britain's cable communications. According to the details made public at a recent meeting at Rennes, wireless communication was established with Hungary May 20, 1920, and will soon be opened with Belgrade. For commercial communication with the United States there is a station at Doua, near Lyons, in addition to the Lafayette station near Bordeaux. Between France and its colonies there will be stations with a range of 7500 miles at Caïgon and at Tahiti. Stations with a radius of at least 4375 miles will be established at Djibouti, Tananarivo, Noumea, and French Guinea. In Africa the system will include stations at Saida and Bamako, which will take care of the traffic between Paris, Algeria and West Africa; another station in Senegal, near Dakar, and finally that of Brazzaville.—*The Scientific American,* August 14, 1920.

HIGH SPEED WIRELESS.—Manual operation is doomed as far as long-distance radio traffic is concerned. The ever-increasing cost of high-powered stations makes it necessary to handle a far greater volume of traffic than can be handled by the usual method. Thus some of the present trans-atlantic stations are operating at 50 words to 100 words per minute by means of automatic transmitters and receivers. In England experiments have been going on for some time with automatic transmitters capable of a normal speed of 450 words per minute, and even 1000 words per minute during demonstrations. The recording is effected by means of a special electro-chemical apparatus. This apparatus consists of a specially prepared paper drawn between a roller and a marking pointer. The arrival of a signal causes a current to pass through the paper, producing discoloration.—*The Scientific American,* September 4, 1920.

WIRELESS TELEGRAPHY IN THE BRITISH ARMY. (*Electrician,* June 25, 1920.)—Instruments used at Woolwich are reported to transmit more than 2000 words per minute. A range of 250 miles with an accuracy of one degree of arc is claimed for a new maniature, revolving direction-finder. Moreover, an instrument has been devised for transforming ground line telegraphic signals into wireless with a normal speed of 450 words per minute.—*The Franklin Institute,* August, 1920.

MISCELLANEOUS

WORLD'S DECREASING COAL OUTPUT.—Figures compiled from official sources show that the world's production of coal for the last completed year, 1919, stood at the lowest figure since 1910. The total production last year was 1,170,000,000 metric tons, lower by 10,000,000 than the figures for 1910 and a decrease of 171,000,000 tons as compared with the year 1913. The figures of the world's coal production for the last seven years are as follows:

	Metric Tons
1913	1,341,000,000
1914	1,208,000,000
1915	1,190,000,000
1916	1,270,000,000
1917	1,336,000,000
1918	1,332,000,000
1919	1,170,000,000

Great Britain is responsible for very nearly one-third of this enormous decrease in production, her output having dropped from 292,000,000 metric

tons in 1913 to 237,000,000 tons in 1919. Belgium's production dropped by the best part of one-fifth of its 1913 total, whilst the French production fell by one-half from 44,000,000 tons to 22,000,000.—*The Nautical Gazette*, Aug. 14, 1920.

EXPERIMENTAL DISTILLATION OF KELP AT LOW TEMPERATURES.—G. C. Spencer, *Journal of Industrial and Engineering Chemistry*, 1920, has made 16 distillations of dried kelp in an oil-jacketed wood retort at temperatures not exceeding 320° C. Aqueous liquor, tar, and a non-inflammable gas were obtained. The residual charcoal was not sufficiently heated for the good extraction of potash or for use as a filtering medium, therefore kelp must be distilled at a much higher temperature.—*The Franklin Institute*, August, 1920.

WIRE ROPES: THEIR USES AND MISUSES.—Steel wire ropes in the hands of competent men are in most cases better and safer than chains, however well made. The strength of a chain is the strength of its weakest link, whereas if a strand in a wire rope breaks, it does not mean that the whole rope will fail.

Wire ropes have also to a great extent replaced hemp and manila ropes, especially in countries where the climate has a bad effect on the latter; the wire ropes are less cumbersome for hoisting, etc. For instance, a hemp rope for hoisting sections in the erection of masts would be much more unwieldy than a steel rope of the same strength. They are also much more suitable for staying the masts, as they can be made taut; whereas, if a hemp rope is made taut and then gets wet, it is liable to fail owing to shrinkage.

These ropes are stronger than the material from which they are made, for the following reason.

Manufacture of Ropes.—The wire from which the rope is made up is at first about twice the diameter of the finished wire; it is then reduced in size by being drawn through a hard steel drawplate. The result of this drawing action is to compress the steel, and at the same time to form a hard skin on the outside of the wire. This skin is, in fact, a thin cylinder which keeps the steel compressed, therefore increasing the density and hence the strength.

This cylinder is perfectly elastic, but not so ductile as the steel inside. If the cylinder is broken in any way, the strength of the rope is reduced 5 per cent to 10 per cent. New ropes are often reduced this amount in strength owing to kinks getting in the rope.

The use of small winding drums is also another cause of this skin becoming cracked. The use of a small drum is the cause of a still more serious action. A rope may pass round a small drum or pulley perhaps a thousand times, and then suddenly fail, the reason being the repeated bending of the wire. So that while kinks usually only reduce the strength of the rope, the use of small winding drums or pulleys is even more dangerous. Steel wire ropes are more flexible than iron ones, but a bad kink will do more harm to a steel rope than to an iron one, as the iron rope is more ductile.

This damaging action by bending depends also on the speed of the winding drum or pulley over which the rope passes. For slow speeds the size of drum should not be less than 80 times the diameter of the rope, and for high-speed winding 120 to 150 times the diameter. Guide pulleys may be less, as the rope does not pass all the way round them. They should never be less than 50 times the diameter of rope.

The weakest point in a rope is at the capping, or where it is attached to the crane hook, or to the anchor in the case of a stay for a mast.

Methods of Capping.—The best method of capping, in fact the only satisfactory method, is as follows:

About 6 inches from the end, the rope is seized. The wires are then frayed out, well cleaned, and put into a cone-shaped casting; then white metal is run in. The efficiency of a rope capped in this way is from 95 to 99 per cent.

Some engineers object to this method of capping, on the ground that the hot white metal anneals the steel. This objection is dealt with in the following manner. It has been proved by experiment that steel is neither reduced in strength nor in hardness, unless it is heated up to the recalescence point, this point being 1441° F. for ordinary purposes. The white metal used may be melted at a temperature of 700° F., and so does not anneal or reduce the strength of the steel in any way whatsoever.

The efficiency of a spliced rope is from 60 to 80 per cent, depending on the man who makes the splice.

The method of capping a rope by splicing a thimble into the end is usually quite good if made by an experienced man. A straight splice is in general nearly as strong as the rope itself, but when it is bent to take the thimble, the wire is not uniformly loaded, so that if it were spliced for double the usual length, it would not be anywhere near the strength of the rope.

The first method also has the advantage that it does not require skilled labor as is the case with a spliced capping.

The efficiency of ropes using the various kinds of screw-grips is from 30 to 50 per cent. The use of any type of grip which tends to deform the rope is bad practice; in the first case, because it crushes the rope, and secondly, because the rope is not uniformly loaded.

The efficiency of a rope is worked out in the following manner:

The rope is first fractured in the testing machine in the usual manner. Then each separate wire is fractured in a smaller machine.

$$\text{Efficiency} = \frac{\text{Total load required to fracture rope}}{\text{Sum of the loads required to fracture each wire.}}$$

Example.—A rope consisting of 49 wires failed at 20 tons.
Each of the 49 wires failed at cwt. 9.

$$\text{The efficiency percentage} = \frac{20 \times 20 \times 100}{9 \times 49} = 92.70$$

Laying of Wire Ropes.—Wire ropes are laid up in two different ways. (1) Ordinary lay. The wires in the strand are laid right-handed, and the strand laid up left-handed in the rope. Ropes laid up in this manner are cheaper to make, and are, or should be, only used for stays and guys, and never for hoisting; the reason being that they wear out very quickly owing to only a small proportion of the wires coming in contact on the drum. (2) Lang's lay. In this method the wires in the strand and the strand in the rope are both laid up in the same way, and hence have a smoother surface and no sharp corners as in the ordinary lay. This rope wears uniformly.

No general formula can be given for the strength of wire ropes, for the simple reason that they vary so much with different makers.

If first-class ropes are used, however, the following are sufficiently accurate:

C = Circumferences, measured in inches.
Breaking load in tons $= 3\,C^2$ (steel).
Breaking load in tons $= 3\,C$ (iron).

The following is an actual test on a steel wire rope, 4 inches in circumference:

Actual breaking load in tons $= 51.7$.
From $3\,C^2$ breaking load in tons $= 48.0$.
so that if dealing with first-class ropes the $3\,C^2$ is quite safe.

For dead loads, such as the load on a mast stay, the safety factor may be taken as five. For live loads, for instance, the rope used to hoist sections in the erection of masts, a safety factor of at least eight should be used. When paying out rope from a coil it should always have the twist taken out as it comes off the coil, otherwise kinks will result; and it should always be laid out flat before being wound on the winch drum.—*Engineering and Industrial Management,* August 19, 1920.

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NOTES ON INTERNATIONAL AFFAIRS

FROM AUGUST 10 TO SEPTEMBER 10

PREPARED BY

PROFESSOR ALLAN WESTCOTT, U. S. Naval Academy

POLAND AND RUSSIA

SECRETARY COLBY STATES AMERICAN POLICY.—In the form of a note to the Italian Ambassador, Secretary of State Colby issued on August 10 an important note outlining the attitude of the United States regarding the Polish-Russian situation. The note stated: (1) that the United States Government believed in a free Polish state and stood unalterably for Poland's political and territorial integrity; (2) that while not intending to put obstacles in the way of peace negotiations between Russia and Poland, it would not participate in a general European conference on the question, for such a conference would involve "two results from both of which this country strongly recoils, viz.: the recognition of the Bolshevist régime and a settlement of the Russian problem almost inevitably upon the basis of a dismemberment of Russia."

The note continuing reiterated the gratitude of the United States to the Russian people and reviewed the historic friendly feeling between the two nations. It pointed out that America had insisted upon recognition of the rights of Russia in settlement of problems in both the Near and the Far East. The latter part of the note consisted of an arraignment of the Soviet Government of Russia, in part as follows:

> It is not possible for the Government of the United States to recognize the present rulers of Russia as a government with which the relations common to friendly governments can be maintained. This conviction has nothing to do with any particular political or social structure which the Russian people themselves may see fit to embrace. It rests upon a wholly different set of facts. These facts, which none disputes, have convinced the Government of the United States, against its will, that the existing régime in Russia is based upon the negation of every principle of honor and good faith, and every usage and convention, underlying the whole structure of international law, the negation, in short, of every principle upon which it is possible to base harmonious and trustful relations, whether of nations or of individuals.
>
> The responsible leaders of the régime have frequently and openly boasted that they are willing to sign agreements and undertakings with foreign powers while not having the slightest intention of observing such undertakings of carrying out such agreements. This attitude of disregard of obligations voluntarily entered into, they base upon the theory that no compact or agreement made with a non-Bolshevist government can have any moral force for them. They have not only avowed this as a doctrine, but have exemplified it in practice.

Indeed, upon numerous occasions the responsible spokesmen of this power, and its official agencies, have declared that it is their understanding that the very existence of Bolshevism in Russia, the maintenance of their own rule, depends, and must continue to depend, upon the occurrence of revolutions in all other great civilized nations, including the United States, which will overthrow and destroy their governments and set up Bolshevist rule in their stead. They have made it quite plain that they intend to use every means, including, of course, diplomatic agencies, to promote such revolutionary movements in other countries.

It is true that they have in various ways expressed their willingness to give "assurance," and "guarantees" that they will not abuse the privileges and immunities of diplomatic agencies by using them for this purpose. In view of their own declarations, already referred to, such assurances and guarantees cannot be very seriously regarded.

Moreover, it is within the knowledge of the Government of the United States that the Bolshevist Government is itself subject to the control of a political faction with extensive international ramifications through the Third Internationale, and that this body, which is heavily subsidized by the Bolshevist Government from the public revenues of Russia, has for its openly avowed aim the promotion of Bolshevist revolutions throughout the world. The leaders of the Bolsheviki have boasted that their promises of non-interference with other nations would in no wise bind the agents of this body.

There is no room for reasonable doubt that such agents would receive the support and protection of any diplomatic agencies the Bolsheviki might have in other countries. Inevitably, therefore, the diplomatic service of the Bolshevist Government would become a channel for intrigues and the propaganda of revolt against the institutions and laws of countries, with which it was at peace, which would be an abuse of friendship to which enlightened governments cannot subject themselves.

In the view of this Government, there cannot be any common ground upon which it can stand with a power whose conceptions of international relations are so entirely alien to its own, so utterly repugnant to its moral sense. There can be no mutual confidence or trust, no respect even, if pledges are to be given and agreements made with a cynical repudiation of their obligations already in the mind of one of the parties. We cannot recognize, hold official relations with, or give friendly reception to the agents of a government which is determined and bound to conspire against our institutions; whose diplomats will be the agitators of dangerous revolt; whose spokesmen say that they sign agreements with no intention of keeping them.

SUMMARY

To summarize the position of this Government, I would say, therefore, in response to your Excellency's inquiry, that it would regard with satisfaction a declaration by the allied and associated powers that the territorial integrity and true boundaries of Russia shall be respected. These boundaries should properly include the whole of the former Russian Empire, with the exception of Finland proper, ethnic Poland, and such territory as may by agreement form a part of the Armenian State.

The aspirations of these nations for independence are legitimate. Each was forcibly annexed, and their liberation from oppressive alien rule involves no aggressions against Russia's territorial rights, and has received the sanction of the public opinion of all free peoples. Such a declaration presupposes the withdrawal of all foreign troops from the territory embraced by these boundaries, and in the opinion of this government should be accompanied by the announcement that no trangression by Poland, Finland, or any other power, of the line so drawn and proclaimed will be permitted.

Thus only can the Bolshevist régime be deprived of its false but effective appeal to Russian nationalism and compelled to meet the inevitable challenge of reason and self-respect which the Russian people, secure from invasion and territorial violation, are sure to address to a social philosophy that degrades them and a tyranny that oppresses them.

The policy herein outlined will command the support of this government.

Accept, Excellency, the renewed assurance of my highest consideration.

BAINBRIDGE COLBY.

FRANCE CONCURS IN AMERICAN POLICY.—Immediately upon the publication of Secretary Colby's note, the French Government sent a message declaring the French and American Policies "entirely in accord." Premier Millerand stated that France also believed in a free Poland and a United Russia, and that it was with these objects in view that France objected to all negotiations with the Bolsheviki and recognized General Wrangel's opposition movement in southern Russia.

WARNS POLAND AGAINST AGGRESSION.—On August 21 the American Government directed a friendly warning to Poland against aggressive warfare. It was stated at the same time by Washington officials that Great Britain, France and Italy had advised Poland to the same effect. The note follows in part:

The United States applauds the steadfast gallantry of the Polish Army in its defense of Warsaw and is sympathetic with all necessary measures which Poland may take to preserve its political and territorial integrity. This Government, however, urges that every reasonable effort be made to terminate the present bloodshed. It could not approve of the adoption of an offensive war program against Russia by the Polish Government.

The American Government is of the opinion that the Polish advance into Russia tended to create a national sentiment in that country which ignored the tyranny and oppression from which the people suffer and afforded an undeserved support to the Bolshevist régime, which enabled its leaders to embark upon the invasion of Polish territory.

To prevent a recurrence of the present situation the United States Government believes that the Polish Government might well take the opportunity afforded by the favorable turn of events to declare its intention to abstain from any aggressions against Russian territorial integrity; to state that its policy is not directed against the restoration of a strong and united Russia, and that pending a direct agreement as to its Eastern frontier, Poland will remain within the boundary indicated by the Peace Conference.

POLAND OBJECTS TO LINE SET BY ALLIES.—In its reply to Secretary Colby's note, the Polish Government on August 31 expressed certain objections to the so-called "ethnographic frontier" indicated by the Peace Conference, and more definitely laid down by the British Foreign Minister, Lord Curzon, in a note of July 20. The objections were chiefly based on the weakness of the line from a military point of view.

POLISH-RUSSIAN NEGOTIATIONS ABORTIVE.—On August 16 Polish and Russian delegates met at Minsk to reopen negotiations for peace. In spite of the collapse of the Russian offensive, the Soviet delegates refused to modify their terms. After futile discussions the conference ended on

August 25 with Poland's practically complete rejections of the Russian proposals.

Poland's reply to the peace terms presented by the Russian Soviet delegation amounts to a flat rejection, says *The Manchester Guardian* Minsk correspondent.

"Out of the fifteen Russian demands, only one, that relative to demobilization, is accepted, and that only on condition that Russia will take a similar course—that is to say, Russia must demobilize at the same time Poland disbands her forces.

"The terms relative to disarmament, the closing of munitions plants and the delivery of munitions to Russia by Poland are indignantly rejected.

"Bolshevist terms relative to a Polish workers' militia and control by the Russians of the railway line from the Bialystok southward are declared beyond discussion. The boundary line between Poland and Russia, as laid down by Earl Curzon, British Secretary of State for Foreign Affairs, is declared unacceptable, as it involves a third partition of Poland."

FURTHER NEGOTIATIONS AT RIGA.—In spite of the failure of the Minsk conference, both Russia and Poland agreed that negotiations should continue, and accepted the port of Riga, in Latvia, as the location for further discussions. It was expected that the delegates would meet at Riga about the middle of September, to consider Poland's counter-proposals.

BRITISH EFFORTS TO AID POLAND.—On August 10 Premier Lloyd George addressed Parliament at length on the Russian situation, reviewing the policy of the government and seeking to justify its efforts to reestablish trade with Russia, and at the same time secure a peaceful settlement of the Russian Polish problem acceptable to Great Britain and the rest of Europe,

Prior to and throughout the Minsk negotiations, Great Britain brought pressure to bear on Russia with this end in view. Both to Poland and Russia, Great Britain proposed the frontier suggested in the Versailles Treaty and stated in Lord Curzon's note of July 20.

On August 23 the Italian and British governments sent a protest through the Russian agents in London declaring that the terms submitted by the Soviet Government to Poland were not in accordance with those previously agreed upon as acceptable to the Allied Powers, and stating that unless these terms were adhered to Poland would be given all possible assistance in her defense. In particular, objection was made to the Russian requirement that Poland should arm 60,000 workers, as a "civic militia."

To this note M. Tchitcherin, the Soviet Foreign Minister, replied on August 26, agreeing to drop the "civic militia," asserting his willingness to continue negotiations, and arguing at length on the merits of the Soviet form of government.

BRITISH LABOR OPPOSES RUSSIAN WAR.—London, Saturday, Aug. 14.—British organized labor yesterday issued what was virtually an ultimatum to the government.

Practically all of the labor and trades union executives in the country have agreed to hand over their powers to the Council of Action, which was authorized to call for any and every form of withdrawal of labor which circumstances may require in order to secure a guarantee against military

or naval operations against Russia, withdrawal of the Russian blockade and recognition of the Soviet Government.

The gravity of the step was then raised by J. H. Thomas, M. P. In moving one of the principal resolutions he said these resolutions "do not mean a mere strike. They mean a challenge to the whole constitution of the country."—*N. Y. Times,* Aug. 14, 1920.

GERMANY STAYS NEUTRAL.—Berlin, Sept. 1 (Associated Press).—Dr. Walter Simons, the Foreign Minister, addressing the Reichstag Foreign Affairs Committee to-day, declared he had been urged to collaborate with the Russian Bolsheviki against the Western powers as a means of breaking the bonds imposed by the Treaty of Versailles but that after mature reflection he had rejected this course.

"If we had followed these exhortations," said the Foreign Minister, "Germany would immediately have become a theatre of war. Furthermore, the disastrous consequences which Bolshevism might be expected to bring with it would have fallen with double force upon Germany."

Dr. Simons said proposals also have been made that Germany co-operate with the Western powers against Russia, which he considered an equally impossible course.

"No power at war with Soviet Russia," the Foreign Minister added, "need count upon our support."

FRANCE RECOGNIZES WRANGEL.—Paris, Aug. 11 (Associated Press).—The French Government has decided to recognize General Baron Peter Wrangel as head of the de facto Government of South Russia. In making this announcement the Ministry of Foreign Affairs said this recognition implied rendering General Wrangel all possible military assistance.

France will send a high commissioner to Sebastopol immediately, the Foreign Office stated.

Two reasons were given by the Foreign Office for recognizing General Wrangel. The first was his promise to assume all the obligations of the former Russian Government. The second was his promise to give Russia a democratic government.

POLAND'S QUARREL WITH LATVIA.—London, Sept. 7.—The Polish Government has addressed an appeal to the League of Nations requesting its mediation in the Polish-Lithuanian dispute, and the League is considering it.

Unless an improvement occurs in the situation Poland will be compelled to declare war on Lithuania, the appeal states, and it charges that an unprovoked attack had been made on the Polish troops by Lithuanian forces.

The Polish demand is, the note indicates, that the Lithuanian troops evacuate Polish territory within a few days.

Paris, Sept. 7.—The Polish note to the League of Nations asking it to mediate in the Polish-Lithuanian controversy says that while the Polish armies were retreating before the Russian Soviet forces the Lithuanian government concluded an agreement with the Soviet government at Moscow authorizing the Soviet Army to make use of Lithuanian territory for its passage and the establishment of a military base. This, the note points out, was a breach of neutrality. The note continues:

"Later when the Polish armies were forced to withdraw from ethnographic Polish territory as awarded Poland by the Supreme Council on Dec. 8, 1919, Lithuanian troops occupied the evacuated territory and committed excesses toward the populations remaining faithful to Poland.

"When the Bolshevist inasion was repulsed the Polish Army reoccupied Suwalki and the Lithuanian Government sent a note to the Polish Government declaring it did not recognize the frontier as fixed by the Supreme Council and asking the Poles to retire behind the line of Grajevo-Augustowo."

LEAGUE OF NATIONS

PLAN OF LEAGUE INTERNATIONAL COURT.—News reports of August 27 contained an outline of the plan for a Court of International Justice as made by the Jurist's Advisory Committee, on which Mr. Elihu Root was the American delegate, and which was in session during the summer at The Hague. Interest in this plan has been increased by the fact that, though the court is intended as an adjunct of the League of Nations, it has been suggested that the Republican Party in the United States, if successful in the elections, would favor it as a substitute for the League itself.

The plan outlined by the Jurists' Advisory Committee of the Council of the League of Nations was drafted at The Hague in the period between June 16 and July 24. It proved for a continuance of the present Permanent Court of Arbitral Justice and for the establishment of a Permanent Court of International Justice, directed to be formed by the covenant of the League of Nations.

The Permanent Court of International Justice is to consist of eleven judges and four alternate judges. These are to serve for nine years. The court is to sit permanently at The Hague, the purpose of the permanent sitting being that the tribunal shall always be ready to determine causes arising between governments where questions strictly of a legal nature are concerned.

The Permanent Court of Arbitral Justice is to be continued as a body to arbitrate disputes between nations.

The judges of the Permanent Court of Arbitral Justice are to nominate the judges of the Permanent Court of International Justice, whose sittings shall also be at The Hague.

In the selection of judges for the new court, the jurists of each nation who are members of the Court of Arbitral Justice are to form groups, each group to choose not more than six candidates for recommendation to the League of Nations. Not more than two of the six candidates of each nation may be citizens of that nation.

In selecting its six candidates each national group in the present Permanent Court is expected to consult with the highest legal authorities of its own country, including societies devoted to the application and interpretation of international law.

In the case of the United States the members of the American group in the present Hague tribunal would consult, under the terms of the plan submitted, with the United States Supreme Court and probably with the American International Law Society and the American Bar Association.

The International Court of Justice is always to be open for adjudicating cases.

The court is to have the right to compel nations to accept adjudication within certain limitations defining the character of the cases to be adjudicated.

The decisions of the new court are to be founded solely on law and on fact, and the members of the court must not compromise.

To overcome the sensibilities of the governments that the court might infringe upon their sovereignty in undertaking to adjust disputes, the Committee of Jurists followed the definition of proper cases for adjudication laid down in Article 13 of the Covenant of the League of Nations. This definition goes a considerable distance beyond prior definitions of what are to be considered justiciable international cases. The appropriate paragraph of Article 13 reads as follows:

"Disputes as to the interpretation of a treaty, as to any question of international law, as to the existence of any fact which it established would constitute a breach of any international obligation, or as to the extent and

nature of the reparation to be made for any such breach, are declared to be among those which are generally suitable for submission to arbitration."

This provision avoids the danger that nations would reject the assumption by the court of the right to adjudicate compulsorily all or nearly all questions of differences between nations.

Any government will have the privilege of bringing to the court any legal question that bears upon any of the matters defined in Article 13 of the covenant. If the government made defendant fails to appear, the court will hear the cause and render its judgment.

In determining cases, the court will be empowered to be guided by international agreements to which the nations involved are parties or which they have accepted; recognized practices accepted as international law; general legal principles that have been recognized by civilized nations; judicial decisions accepted by eminent jurists of various nations.

If a nation involved in a dispute before the court is represented on the court this will not exclude that judge from participating in the case.

If a nation which is a party to a dispute is not represented on the court it will have the privilege of naming a member of the court to sit in the adjudication of the case as a special judge for the occasion.

If any nation not a member of the League of Nations wishes to have a case adjudicated before the court it could qualify for that purpose by accepting the obligations defined in Article XVII of the League covenant and by paying its proportional portion of the expenses of the adjudication.—*N. Y. Times*, Aug. 28, 1920.

The plan does not provide the means of enforcing the decrees of the court. That means is found in the provisions of the League of Nations covenant for concerted action to bring a recalcitrant nation to accept the dictates of the League.

IRELAND

LLOYD GEORGE'S TERMS TO IRELAND.—London, Aug. 16.—In reply to a question in the House of Commons to-day, Premier Lloyd George again announced the willingness of the government to discuss with any representatives of Irish opinion any proposals for a settlement.

The Premier said such discussion would be subject to three conditions, as follows:

First, that the six counties of Northern Ulster must be treated separately; second, that there must be no secession directly or indirectly of any part of Ireland from the United Kingdom, and third, "We cannot agree to anything that would involve any detraction from the security of these islands or of their safety in case of war."

The Sinn Feiners would not be ruled out if they were prepared to accept these conditions, Premier Lloyd George said.

LLOYD GEORGE OBDURATE AGAINST HUNGER STRIKERS.—September 7 was the twenty-eighth day since the eleven hunger strikers in Cork jail refused food. Terence MacSwiney, Mayor of Cork, the chief of the political offenders was at that time at the point of death.

Lucerne, Sept. 5 (Associated Press).—Premier Lloyd George of Great Britain has replied in the negative to the message of Mayor Hylan of New York City, which urged the Premier to release Mayor MacSwiney of Cork from prison. The Premier in his reply, dispatched yesterday, stated politely but firmly that he could not interfere with the course of justice and law.—*N. Y. Times*, Sept. 6, 1920.

ITALY

WORKMEN SEIZE FACTORIES.—Rome, Sept. 7.—The employers in metal working factories which have been seized by workmen in the present contest over conditions in this industry have received five days in which to comply with the workingmen's demands, according to a resolution passed by the Socialist members of the General Federation of Labor. If the employers do not yield, a rapid movement toward general nationalization is threatened. So far the manufacturers are persisting in their decision not to enter into direct negotiations with the workers before the latter evacuate the factories.

It is estimated that 400 of the largest metal works in Italy have been occupied by mechanics and workers, and the movement is still expanding, threatening to extend to the extreme southern end of the peninsula. Elaborate steps have been taken by the government to preserve order during the period when a general offensive against all industries is threatened.—*N. Y. Times*, Sept. 8, 1920.

NEAR EAST

ENGLAND FREES EGYPT.—London despatches of August 23 carried definite information regarding Great Britain's decision to grant Egypt virtual independence.

The decision according to the London *Times*, resulted from recent conversations here between the Viscount Milner's mission, which recently visited Egypt, and an Egyptian delegation headed by Said Zagloul Pasha, former Minister of Justice.

Among the fundamental points of the agreement are:

"Egypt will recognize Great Britain's privileged position in the valley of the Nile and agree, in case of war, to afford every facility for access to Egyptian territory. Great Britain will maintain a garrison in Egypt in the Canal zone. Egypt regains control of foreign relations, subject to her not making treaties contrary to British policy, and will have the right to maintain diplomatic representatives abroad. Capitulations will be abolished."

A BALKAN COALITION.—To protect themselves primarily against the reactionary government of Hungary, and also against Russia or other powers inimical to the nearly formed Balkan nations, the Czechoslovak, Jugoslav, and Roumanian governments have formed a defensive alliance which has been given the name of the "little entente." Vienna reports state that British and French officials do not view with entire approval this action of the Balkan States in coming to an understanding independently of the chief European powers.

GREEK PREMIER WOUNDED.—On the night of August 12, Premier Venizelos of Greece was shot at and wounded in the shoulder and thigh while entering the Lyon railway station in Paris. His assailants were two Greek officers, adherents of the former King Constantine. M. Venizelos's recovery was later reported.

At the time of the attack the Premier was returning to Greece after the signing of the Turkish Treaty at Sévres on August 10. This treaty marked a triumph of Venizelos and of Greek policy, its terms more than doubling the 30,000 square miles of Greece and quadrupling its former population of 3,000,000.

BULGARIAN TREATY RATIFIED.—Paris, Aug. 9.—The Peace Treaty with Bulgaria was made formally effective by the exchange of ratifications today among the powers which are parties to it.

The treaty was signed at Neuilly on November 27, 1919, and was ratified by the Bulgarian Sobranje January 12 of this year. France's ratification of the treaty was completed by the favorable action of her Senate on July 31.

MEXICO

TERMS FOR RECOGNITION.—On August 17 the Mexican Government published a message to President de la Huerta from Señor Calderon, the Mexican High Commissioner in Washington, purporting to present the terms upon which the United States would recognize the new Mexican Government. These terms were:

First—That North American lives and property be respected.

Second—That indemnities be paid to foreigners who suffered during the revolution.

Third—That the Carranza decrees which are found to be confiscatory be derogated.

Washington officials later stated that these terms were only "a few of the conditions announced," that the United States wanted performance more than promises, and that it would delay recognition until the new government proved its strength and intentions.

OBREGON ELECTED PRESIDENT.—Early announcements of the elections held in Mexico on September 5 assured the election of General Obregon as President.

PROTEST AGAINST OIL POLICY.—Washington, Sept. 7.—It was officially made known at the State Department to-day that instructions were sent to the American Embassy in Mexico City, about three weeks ago, to notify the Mexican Government that the United States regarded the operation of the "denouncement law" and the Federal zone law in the oil fields as an infringement of the rights of Americans under international law.

It was said at the department to-day that no report on the delivery of these warnings to the Mexican Government had been received from the embassy, and the report that Provisional President de la Huerta had refused to receive the communication because it was couched in "impossible" language is discredited by the officials. It was said that if such a situation arose Chargé d'Affaires Summerlin would immediately communicate the facts to the department.—*N. Y. Times,* Sept. 8, 1920.

JAPAN

ANGLO-JAPANESE ALLIANCE.—It was learned on September 3 that the American, British, and Japanese governments were engaged in informal conversations respecting the terms of the Anglo-Japanese Treaty, which was renewed in July for only one year. There is no suggestion that the United States will become a third party to the treaty, but it is evident that a better understanding among the three powers regarding their interlocking interest in the Far East will lessen the tension in that quarter. There is need in particular of a more definite understanding regarding Japan's "special interests" in China, which were recognized in the Lansing-Ishii Agreement,

but which the United States refuses to regard as justifying Japan in establishing a "Monroe Doctrine" for the East.

On the same date Secretary Colby and Governor Stephens of California conferred regarding the Japanese situation. California in November will cast a referendum vote on the question of more drastic legislation against Japanese land holding.

REVIEW OF BOOKS

ON

SUBJECTS OF INTERNATIONAL AFFAIRS

"Marine Engineers' Handbook."—Sterling. 1450 pages, fully illustrated. Index of 28 pages. (Published by McGraw-Hill Book Company, Inc., New York.)

This handbook, as its preface states, is compiled for the use of operating and designing engineers and of students.

It will supply the need long felt by Marine Engineers for a handbook covering every phase of marine engineering.

It is divided into fifteen sections with subdivisions.

Every section being prepared by a recognized expert gives the best practice and the most approved modern theory of marine engineering.

It includes: Section 1. Mathematical Tables and Formulæ, Mechanics of Rigid Bodies; Section 2. Non-Ferrous Metals and Alloys, Iron and Steel, Oxy-Acetylene Welding, The Thermit Welding Process, Heat; Section 3. Coal, Oil Fuel, Combustion Oil Fuel Burning; Section 4. Boilers; Section 5. Turbines, Mechanical Reduction Gears; Section 6. Reciprocating Engines; Section 7. Marine Diesel Engines; Section 8. Vacuum and Condensers; Section 9. Ships Forms and Powering, Screw Propellers; Section 10. Evaporators and Distillers, Oil Coolers and Feed Water Heaters, Centrifugal Pumps, Reciprocating Pumps, Air Compressors, Centrifugal Fans, Heating and Ventilating, Deck Machinery; Section 11. Piping, Valves and Fittings, Reducing Valves and Pumps, Governors, Steam Traps, Pipe Covering and Lagging; Section 12. Marine Electrical Installation; Section 13. Lubrication and Lubricants; Section 14. Measuring Horsepower of Marine Engines; Section 15. Tests, Trials, Inspections, Classification Societies.

The book is concluded with a very valuable chapter giving the names and addresses, and duties or aims of societies, associations and commissions which have various functions utilized by Marine Engineers in planning and executing Marine Engineering work.

This handbook is a valuable work and deserves a permanent place in the library of all marine engineers, whether designer, operator or students. It also will supply much valuable information to other engineers.

W. L. F.

"Forty Years in the Pacific." By Frank Coffee. 350 pages. (Published by the Oceanic Publishing Company.)

An account of wanderings in the Pacific covering many years, told in a wandering style. The author tells of many voyages and deals more or less fully with the description, physical geography, history and customs of

the places visited with deviations into personalities and "that reminds me's."

There is much information of value to the prospective traveler by sea, such as time, day's run, oil burning, amusements, wireless, cables and even advice as to the prevention of seasickness. Unfortunately the information regarding the little known spots such as Fiji, Yap, Solomons, is meager, being mostly abridged from other works.

The author begins with a history of navigation in the Pacific, then describes voyages to Auckland, Sidney, Canton, the Philippines, Honkong, Japan Hawaiian Islands, Norfolk, Lord Howe and Christmas Islands, the latter the scene of the wreck of the *Aeon* upon which were the wives of Capt. W. K. Reddle and Capt. B. R. Patrick, Ch. C. U. S. N. Then follow New Caledonia, New Hebrides, British Solomon Islands, Gilbert Islands, Dutch New Guinea, Tahiti, Tonga Samoan Islands, Fiji, New Zealand, with information upon Polynesian pastimes, volcanoes, copra, sugar and other products, favorite forms of "Tipple," missionaries, fish stories, Then follow miscellaneous short articles upon wireless, Alaska and Yukon telegraph, submarine signals, oil and fuel used at sea, difference of time, rule of the road at sea, classification and tonnage. Alaska and Australia are dealt with quite fully, and the Pelew Caroline, and Marshall Islands and German New Guinea briefly. The rest of the book is taken up with "random notes."

This work should be of value in ship's libraries, though much of it is of little value to sea-going people. It is of great value to the prospective traveler in the Pacific.

B. C. A.

"Navigation by Position Lines, or Marcq Saint-Hilaire, Method:" By J. W. Saul.

This book is a distinct contribution to the further spread of the knowledge of a method of navigation, which is unquestionably the best so far found. This method, which is a development of the old Sumner position line, has been practically standard in the United States Navy for several years.

The haversine formula advocated by the author is the one most used, but in a somewhat different form, although the sine-cosine formula, the versine formula, or the numerous types of spherical traverse tables may be utilized.

Using the author's abbreviations (ref. page 5) the following is the formula recommended by both Bowditch and Muir:

$$\text{Lhav}\,\theta = \text{Lhav P} + \text{Lcos lat} + \text{Lcos dec.}$$

(The (-20) is only to adjust the logarithmic characteristic.)

$$\text{Nathav zen. dist.} = \text{Nathav}\,\theta + \text{Nathav (lat} \sim \text{dec.)}$$

It will be noted that the use of this formula requires less subtraction, and therefore reduces the probability of error. From the zenith distance, by the above, the "computed altitude" is found and this combined with

the "true altitude," gives the "altitude difference" or the "intercept," which is the number of miles, the position line must be removed from the dead reckoning position, toward the body if the true altitude is greater, and away if the true altitude is less.

It is to be regretted that the author did not include the formula for the great circle course, as well as the distance, as it would have made the book more complete.

In another edition, the book should be more carefully gone over, as there are some slight errors in the statements of the problems and their solutions which do not however affect the principles involved.

A. M. R. A.

"Sea Power in the World War." By Captain R. Bernotti, Italian Navy.

This work consists of a review of the World War in order to draw the lessons in tactics, strategy and organization that actual experience has tested out and shown to be successful.

Captain Bernotti makes a brief review of the naval forces of the world powers, leading up to the war and the political attitude of these powers, and development of their naval strength in consequence of that attitude.

He handles the strategy under the three geographic groups of Baltic and North seas, Mediterranean and Black seas and the general operations on the High Seas, including Tsing Tau, the Pacific and the South Atlantic.

A special chapter is given to the submarine warfare against the merchant service and another to the overseas expeditions.

Under naval tactics after a brief review of the changes since Japanese-Russian War showing the great development in fire control, he reviews the various cruiser actions and finally gives a chapter on the Battle of Jutland. This is a very interesting chapter, as well as the two following ones in which he shows the effect that the long range torpedo from the destroyer, and the short range torpedo of the submarine have had on the battleship tactics. The general subject of approach, and the need for formations for quick deployment are also discussed.

In conclusion Captain Bernotti emphasizes the need for underwater protection, giving a table of losses of naval vessels during the war in which only 17 per cent was due to gunfire, the torpedo and the mine accounting for the rest.

R. H. J.

NOTICE TO MEMBERS

More members, both regular and associate, are desired. Any increase in membership invariably means a larger number of articles submitted, and consequently an improvement in the PROCEEDINGS.

You are requested to send or give the attached slip to some one eligible for membership, urging him to join.

By direction of the Board of Control,

H. K. HEWITT,
Secretary-Treasurer.

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.... *192*

Secretary and Treasurer,
U. S. Naval Institute,
Annapolis, Md.

Dear Sir:

Please enroll my name as a { *subscriber* / *regular member* / *associate member* } *of the U. S. Naval Institute from*..................

Very truly yours,

____

____

For eligibility as to membership and for difference between members and subscribers see opposite page (Constitution).

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NOTICE

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It is now in its forty-seventh year of existence. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers upon subjects of interest to the naval profession, as well as by personal support.

On the subject of membership the Constitution reads as follows:

ARTICLE VII

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control. To be declared elected, they must receive the affirmative vote of three-quarters of the members represented at regular or stated meetings, either in person or by proxy.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control. The Board of Control will at each regular meeting ballot on the nominations submitted for election, and nominees receiving a majority of the votes of the board membership shall be considered elected to membership in the United States Naval Institute."

Sec. 8. The annual dues for regular and associate members shall be three dollars, all of which shall be for a year's subscription to the United States Naval Institute Proceedings, payable upon joining the Institute, and upon the first day of each succeeding January. The fee for life membership shall be forty dollars, but if any regular or associate member has paid his dues for the year in which he wishes to be transferred to life membership, or has paid his dues for any future year or years, the amount so paid shall be deducted from the fee for life membership.

ARTICLE X

Sec. 2. One copy of the Proceedings, when published, shall be furnished to each regular and associate member (in return for dues paid), to each life member (in return for life membership fee paid), to honorary members, to each corresponding society of the Institute, and to such libraries and periodicals as may be determined upon by the Board of Control.

The Proceedings are published monthly; subscription for non-members, $3.50; enlisted men, U. S. Navy, $3.00. Single copies, by purchase, 30 cents; issues preceding January, 1920, 50 cents.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ARTICLE, 1921

A prize of two hundred dollars, with a gold medal, and a life-membership (unless the author is already a life member) in the Institute, is offered by the Naval Institute for the best original article on any subject pertaining to the naval profession published in the PROCEEDINGS during the current year. The prize will be in addition to the author's compensation paid upon publication of the article.

On the opposite page are given suggested topics. Articles are not limited to these topics and no additional weight will be given an article in awarding the prize because it is written on one of these suggested topics over one written on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. All original articles published in the PROCEEDINGS during 1920, which are deemed by the Board of Control to be of sufficient merit, will be passed upon by the Board during the month of January, 1921, and the award for the prize will be made by the Board of Control, voting by ballot.

2. No article received after November 1 will be available for publication in 1920. Articles received subsequent to November 1, if accepted, will be published as soon as practicable thereafter.

3. If, in the opinion of the Board of Control, the best article published during 1920 is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention," or such other distinction as the Board may decide.

4. In case one or more articles receive "Honorable Mention," the writers thereof will receive a minimum prize of seventy-five dollars and a life-membership (unless the author is already a life member) in the Institute, the actual amounts of the awards to be decided by the Board of Control in each case.

5. It is requested that all articles be submitted typewritten and in duplicate; articles submitted written in longhand and in single copy will, however, receive equal consideration.

6. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

H. K. HEWITT,
Commander, U. S. N., Secretary and Treasurer.

TOPICS FOR ARTICLES

Suggested by Request of the Board of Control

"Rebuilding the Navy's Enlisted Personnel, and Reestablishing Its Morale and Spirit After the Serious Slump Caused by too Rapid Demobilization and High Wages in Civil Life."
"The Human Element in the Administration of Discipline."
"A Demobilization Programme for the Future."
"The Mission of the Naval Academy in the Molding of Character."
"Health of Personnel in Relation to Morale."
"Physical Factors in Efficiency."
"The Naval Officer and the Civilian."
"Naval Bases, Their Location, Number and Equipment."
"Military Character."
"The Ability to Handle Men a Necessary Element in the Equipment of a Naval Officer."
"The Relation of Naval Communications to Naval Strategy."
"The Relation of Naval Communications to Naval Tactics."
"The Training of Communication Officers."
"The Organization of a Naval Communication Service."
"The Naval Policy of the United States."
"A Review of the Battle of Jutland with Lessons to be Learned Therefrom."
"Modification in the Design and Armament of Ships to Meet the New Conditions of Aerial and Subsurface Attack."
"Coordination of Surface, Subsurface and Aerial Craft in Naval Warfare."
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"Is a League of Nations *Navy* Desirable?"
"The Adaptability of Oil Engines to all Classes of War Vessels."
"The Place of Mines in Future Naval Warfare and the Rules under which Their Use Should be Allowed."
"The Use and Abuse of the Doctrine of Continuous Voyage."
"The Question of the Future Use of Submarines."

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NAVAL EDUCATION. First Honorable Mention. By Lieut. Commander C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

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SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882

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"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut. Commander F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

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"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

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1885

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

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What Changes in Organization and Drill Are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

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1900

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901

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BATTLE REHEARSALS. A Few Thoughts on Our Next Step in Fleet-Gunnery. First Honorable Mention, 1907. By Lieut. Commander Yates Stirling, U. S. N.

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Navy Yard Economy. Prize Essay, 1911. By Paymaster Charles Conard, U. S. N.

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UNITED STATES NAVAL INSTITUTE PROCEEDINGS

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE HIGH SEA FLEET AT JUTLAND

By Lieut. Commander H. H. Frost, U. S. Navy

The North Sea mist on 31 May, 1916, concealed the movements of the High Sea Fleet as effectively from the historian as it did from Admiral Jellicoe. The positions of more or less unknown German ships at certain times were known, but it has been necessary in most cases to guess the identity of the ships sighted, their movements from position to position and the motives of their leaders. The German official report was correct, but was so generally worded that the detailed facts could not be deduced from it; the British report did not give much important information of the German movements, because the High Sea Fleet was concealed from the British vessels during some of the most critical phases of the battle by mist and smoke.

Admiral Scheer has now given much valuable information in his recent book, "Germany's High Sea Fleet in the World War." It is true that he might have been more specific, especially as regards the exact courses steered; it is not even stated whether the few courses given are true or magnetic, but a careful comparison of the text with his sketches leads to the conclusion that they were true. In this account all courses are given as true, the variation of 14° having been subtracted from all British courses. Greenwich mean time is used, two hours being subtracted from all German times.

Another important authority is the book entitled "The Two White Nations," by Korvetten-Kapitan Georg von Hase, chief gunnery officer of the battle cruiser *Derfflinger,* numerous reviews of which have appeared in British articles. This book gives many exact courses steered by the German battle cruisers. Admiral Tirpitz devotes a few pages of his book to the battle. A number of short papers from German sources relating to the action have been published.

As the movements of the British forces have been described so many times they will not be repeated here except in so far as to render the narrative intelligible. A naval battle can be most clearly described by the use of sketches; for this reason numerous sketches have been drawn. These must not be considered as track charts of the action, as they are meant only to illustrate the general course of the battle; it is not pretended that the courses of individual units are more than approximately correct, although they have been drawn with care after consulting all available information.

As it is considered that the exact facts must be developed before fair and valuable criticism should be attempted, no comments on the handling of the opposing forces are contained in this paper.

I. THE MISSION OF THE HIGH SEA FLEET

On 18 January, 1916, Vice Admiral Scheer, who had from the outbreak of the war commanded the second, and later the third, battle squadron of the High Sea Fleet, was promoted to commander-in-chief upon the illness of Admiral von Pohl.

On 21 March, 1915, Von Tirpitz had written: "The order that battle must be sought *à tout prix* cannot be issued, but must be locked in the breast of the person concerned." He could have no cause for complaint on this ground after the appointment of Admiral Scheer. The commander-in-chief's object was to make the enemy "feel the gravity of the war." According to his statement, his means for accomplishing this object were the following:

1. U-boat trade war.
2. Mines.
3. Trade war in the North Sea and the Ocean.
4. Aerial warfare.
5. Aggressive action of the High Sea Fleet in the North Sea.

"The U-boat and aerial war," he writes, "had started already; the three other factors were to be operated in combination." His first task was to organize the defenses of the German Bight; a large number of seaplanes, outpost vessels, patrol vessels and mine-sweepers were constantly on their stations; these forces were to be supported by the High Sea forces in the event of an enemy attack; for this purpose about half the destroyer flotillas, light cruisers, battle cruisers and battleships were maintained ready for getting under way on 45 minutes notice; there was always one destroyer flotilla at Heligoland ready to get under way immediately; the remainder of the fleet was kept on three hours notice.

The first operations of the High Sea Fleet were to be night sorties into the North Sea for a short distance outside the German Bight "to destroy enemy forces stationed there, to hold up suspicious craft and to be in readiness to afford help to airships raiding England." The forces used in these sorties were several destroyer flotillas, led by a light cruiser; they were supported by a scouting division of light cruisers and sometimes by the battle cruiser division.

The next operations were to be similar night sorties prolonged until daylight in order to cover a more extended area. In such cases several flotillas of destroyers were to proceed in advance; after them would come a division of light cruisers and one of battle cruisers; the entire High Sea Fleet was to follow in support. Such operations were designed to reach the Skagerrak and the approaches to the channel. It was such a sortie that caused the Battle of Jutland.

"Finally," writes Admiral Scheer, "other important enterprises were planned, such as the bombardment of coastal towns, to exercise a still greater pressure on the enemy and induce him to take counter-measures which would afford us an opportunity to engage a part or all of his fleet in battle under conditions favorable to ourselves." Such an operation was the attempted raid against Sunderland on 19 August, 1916, two and a half months after the Battle of Jutland.

In all the operations of the High Sea Fleet the naval corps in Belgium was to furnish U-boats, which were to be stationed off the English coast while the High Sea Fleet was at sea.

II. THE EXECUTION OF ADMIRAL SCHEER'S PLAN

On 11 February, 1916, the execution of the German plan was commenced by a raid against the British guardships off the Dogger Bank; this operation was carried out by Captain Hartog, the first leader of the Destroyer Flotillas, in the light cruiser *Rostock*, accompanied by Destroyer Flotillas II, VI, and IX. According to German accounts, two British guardships were believed to have been sunk; British accounts admit the loss of the sloop *Arabis*.

During the first years of the war the commander-in-chief of the High Sea Fleet had been greatly restricted by the orders of the Kaiser; in fact, at one time the instructions for any operation of the fleet had to be approved by the Kaiser before they could be executed. This important disadvantage was removed when on 23 February, 1916, the Kaiser stated before an assembly of admirals and officers of the fleet that he had fully approved the program of activities drawn up by Admiral Scheer. "This announcement," says Scheer, "was of great value to me, as thereby, in the presence of all the officers, I was invested with authority which gave me liberty of action to an extent I had myself defined. The intentions of the commander-in-chief were thoroughly understood in this circle, as I had discussed in detail the program of operations and had handed it in writing to those whom it concerned."

On 5 March the first important operation of the High Sea Fleet was undertaken. While three dirigibles bombed the Humber Area, the fleet ventured into the approaches to the channel. The naval corps in Belgium stationed twelve U-boats off the southeast coast of England. No British forces other than submarines were sighted by the battle squadrons, but the cruise proved valuable for drill and exercises in the handling of the fleet.

On 25 March a British bombing attack on the dirigible sheds at Tondern was attempted. Five British planes, launched from aircraft carriers or tenders were captured by the Germans without being able to reach their objectives. In fact, the Germans, even after the attack, did not know what its objective had been. The British destroyer *Medusa* was lost; the British state that it was injured in a collision; the Germans that it had been hit by a bomb dropped by a seaplane; possibly both are correct. The Germans lost the destroyer *S-22*, which hit a mine. "The hurrahs from the crew, led by the commander, proved that they stood firm

to their posts to the very last." Only seventeen men were saved. The fleet received orders to put to sea, but the cruisers which went out first reported that the sea was so rough that an engagement was impossible, and the pursuit of the British forces was cancelled.

On 24 April the High Sea Fleet again put to sea. The U-boats attached to the fleet were stationed off the Firth of Forth; the naval corps stationed two boats off Yarmouth, the objective of the attack. When the fleet had been at sea only four hours, the *Seydlitz* struck a mine; her speed was reduced to 15 knots, and she returned to port. During the night six Zeppelins bombed the coastal towns; at daybreak the battle cruisers bombarded Lowestoft and Yarmouth and then commenced their return. Contact was then made with cruisers of Commodore Tyrwhitt's force and fire was opened on them at 14,000 yards range; some hits are claimed by the Germans. During the return of the fleet British submarines attacked unsuccessfully, but no other hostile forces were sighted.

On 18 May Admiral Scheer issued the following order for the attack on Sunderland:

> The bombardment of Sunderland by our cruisers is intended to compel the enemy to send out forces against us. For the attack on the advancing enemy the High Sea Fleet forces to be to the south of the Dogger Bank, and the U-boats to be stationed for attack off the East coast of England. The enemy's ports of sortie will be closed by mines. The Naval Corps will support the undertaking with their U-boats. If time and citcumstances permit, trade war will be carried on during proceedings.

Three days previously the sixteen U-boats attached to the fleet had commenced scouting in the North Sea. From 23 May to 1 June they were to be in their assigned positions off the British coast. They were ordered to report all enemy forces sighted and to attack whenever opportunity offered. By the 23d the sixteen boats were disposed about as follows:

Off Scapa	About three.
Off Moray Firth	One.
Off Firth of Forth	Seven.
Off the Humber	About two.
Terschelling Bank	About three.

Amongst the boats was the *U-53*, commanded by the well-known Captain Hans Rose.

Day after day passed with the weather conditions unsuitable for the use of Zeppelins for scouting. This important arm of the service of information was considered essential for an operation involving the bombardment of the English coast. As the time for the submarines to be on their stations approached its end, Admiral Scheer on 30 May changed the enterprise to "a campaign against cruisers and merchantmen outside and in the Skagerrak, with the expectation that the news of the appearance of our cruisers in those waters would be made known to the enemy." With this object in view, Admiral Hipper was told to deliberately show himself in sight of the coast of Norway, so that the enemy might be notified.

At 2 a. m. 31 May Vice Admiral Hipper with the scouting forces left the Jade Basin with orders to advance toward the Skagerrak out of sight of Horn Reefs Lightship, to show himself off the Norwegian coast before dark, to cruise during the dark period of six hours in the Skagerrak and to join the battle fleet at 10 a. m. of the 1st of June. The battle fleet followed the scouting forces to sea at 2.30 a. m.

On the two previous enterprises Admiral Scheer had left in port the Second Battle Squadron of pre-dreadnoughts; this time he included this squadron in the battle fleet, principally to raise the morale of their crews by a sea voyage with a chance of meeting the enemy; Admiral Mauve, the squadron commander, had made an eloquent appeal to be allowed to go with the fleet, and as Scheer had himself commanded this squadron for a long time he felt unable to refuse this request. They were a very doubtful reinforcement and never went to sea with the battle fleet again.

At 5.30 a. m. *U-32,* in position about 70 miles east of the Firth of Forth, reported having sighted two battleships, two cruisers, and several destroyers steering to the southeast; at 6.48 *U-66* in position about 60 miles east of Kinnaird Head reported having sighted eight battleships, with accompanying light cruisers and destroyers on a northeasterly course.

Between noon and 1 p. m. *L-9, L-14, L-16, L-21,* and *L-23* commenced long-distance scouting in a sector from north to west of Heligoland; no vessels were sighted by any Zeppelin.

At 2 p. m. Hipper and Beatty were almost in contact. It will now be appropriate to make a brief comparison of the opposing fleets.

III. Comparison of the Opposing Fleets

The following table gives a brief summary of the numbers, displacements and relative values of the important types engaged in action:

Type	British No.	British Dis.	German No.	German Dis.	British superiority
Battleship	28	647,550	16	363,360	1.78 to 1.
Battle Cruiser.	9	196,900	5	118,710	1.66 to 1.
Light Cruiser.	26	108,290	11	44,726	2.42 to 1.
Destroyer	78	77,200 *	77 or less	60,300 *	1.28 to 1.

The aggregate displacement of the Grand Fleet was 1,029,740, as against 587,096 for the High Sea Fleet. A comparison of these displacements indicates that the British superiority was 1.75 to 1 or 7 to 4. If the vessels to be compared are of approximately the same age, the displacement gives the only fair comparison; the average age of the British ships was a little less than that of the German ships, due to the fact that the British had placed in commission a great many vessels since the beginning of the war, while the Germans had completed a comparatively small number of vessels; no less than ten British battleships which were present at the action had been commisioned after the beginning of the war.

In addition to the ships above enumerated the British had eight armored cruisers, one seaplane carrier and one mine-laying destroyer. The Germans had six obsolete battleships.

IV. The Position and Dispositions of the High Sea Fleet (Figs, 1, 2 and 3)

At 2 p. m., Greenwich mean time, Vice Admiral Scheer with the battle fleet was about 50 miles off the coast of Denmark and about 125 miles distant from Heligoland.

The battleships were apparently proceeding on course North at a speed of 14 knots in one long column with distances of 700 meters between ships and intervals of 3500 meters between the

* Approximate.

last ship of the leading squadron and the first ship of the following squadron. The ships were in the following order:

Battle Squadron III:
Konig, Rear Admiral Behncke.
Grosser Kurfurst.
Markgraf.
Kronprinz.
Kaiser, Rear Admiral Nordmann.
Prinz Regent Luitpold.
Kaiserin.

Fleet Flagship (Leading B. S. I.).
Friedrich der Grosse, Vice Admiral Scheer.

Battle Squadron I:
Ostfriesland, Vice Admiral Schmidt.
Thuringen.
Helgoland.
Oldenburg.
Posen, Rear Admiral Engelhardt.
Rheinland.
Nassau.
Westfalen.

Battle Squadron II:
Deutschland, Rear Admiral Mauve.
Pommern.
Schlesien.
Schleswig-Holstein.
Hannover, Rear Admiral Baron von Lichtenfels.
Hessen.

The main fleet was accompanied by the following light forces:

Scouting Division IV:
Stettin, Commodore von Reuter.
Munchen.
Frauenlob.
Stuttgart.
Hamburg.

Destroyer Forces:
Rostock, Commodore Michelsen, First Leader of the Destroyer Forces.
Flotilla I.
Flotilla III.
Flotilla V.
Flotilla VII.

The dispositions of the light cruisers and destroyers are not stated accurately; the light cruisers were stationed ahead but

they are not mentioned as taking any part in the action until about 8.30 p. m.; the destroyers were formed about the battle squadrons as an anti-submarine screen.

Fifty miles to the northward and westward of Scheer were the scouting forces under the command of Vice Admiral Hipper.

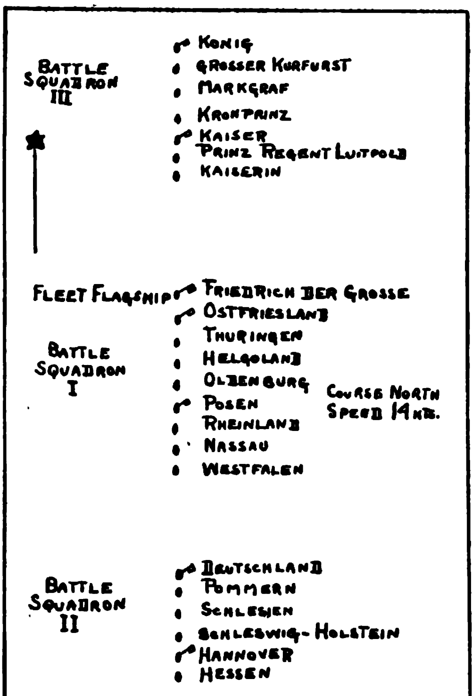


FIGURE 1 HIGH SEA FLEET AT 2 P.M. G.M.T.
DISTANCE BETWEEN SHIPS – 700 METERS
INTERVAL BETWEEN SQUADRONS – 3500 METERS

The main fighting strength of this force consisted of five battle cruisers disposed in column in the following order:

Scouting Division I:

Lutzow, Vice Admiral Hipper.
Derfflinger.
Seydlitz.
Moltke.
Von der Tann.

Admiral Hipper was accompanied by the following light forces:

Scouting Division II:

Frankfurt, Rear Admiral Bodicker.
Pillau.
Elbing.
Wiesbaden.

Destroyer Forces:

Regensburg, Commodore Heinrich, Second Leader of the Destroyer Forces.
Flotilla II.
Flotilla VI.
Flotilla IX.

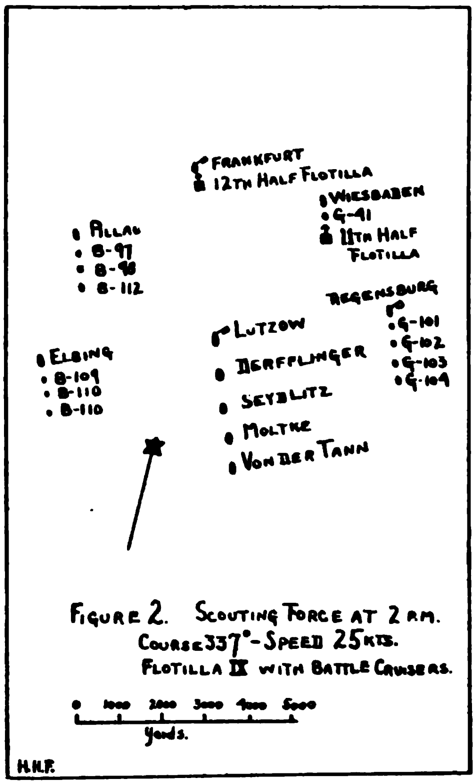
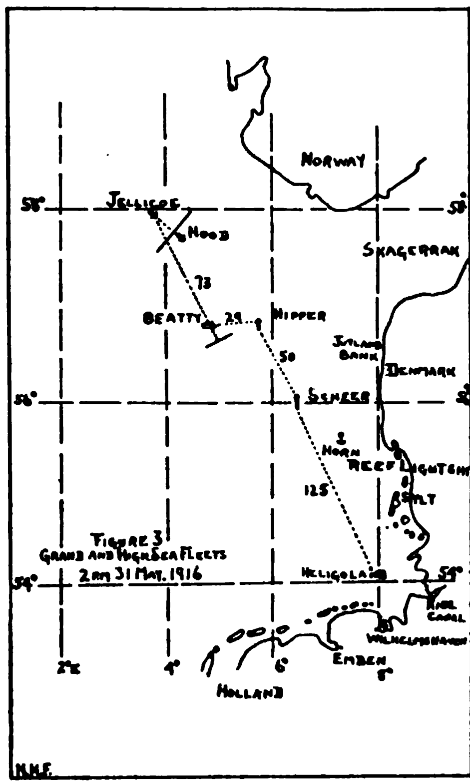


FIGURE 2. SCOUTING FORCE AT 2 P.M.
COURSE 337°-SPEED 25 KTS.
FLOTILLA IX WITH BATTLE CRUISERS.

The names of all the vessels composing the High Sea Fleet are therefore known with the exception of the destroyers; Admiral Scheer gives only the flagboats of flotillas and half flotillas in his list, but in a sketch gives the names of the ten large destroyers

of Flotilla II and throughout his account mentions boats by name whenever they did any special duty; the oldest boat named is *V-4* and the newest boat *B-112*. Normally the German flotilla was composed of 11 boats, one of them being the flotilla flagboat, while the remainder were formed into two half flotillas of five boats each; one of the five boats in a half flotilla was used as its flagboat. If all the German flotillas were at full strength, there would have been 77 boats present; but it seems unreasonable to believe that every boat would be in material readiness at any one time; also there might have been vacancies in the organization due to vessels recently sunk or sent on detached duty; these prob-



abilities are supported by the fact that *G-39* is listed as the flagboat of both Flotilla I and the 1st Half Flotilla and that only ten boats of Flotilla II are listed in the sketch. It is therefore probable that no more than 75 destroyers were present. Never-

theless, for the purpose of computing the aggregate displacement of the destroyers, it has been assumed that all 77 boats were present.

At 2 p. m. Scouting Division I was proceeding in single column on course about 337° at 25 knots. The light forces were disposed in a semicircular screen ahead of the *Lutzow* at a distance of about 2 miles, assuming that the German sketch is drawn to scale. As Flotilla IX is not shown in the sketch and as it was the first to attack, it was probably either concentrated near the *Lutzow* or disposed as an anti-submarine screen about the battle cruisers.

V. THE FIRST CONTACTS AND APPROACH
(2.30 to 3.30 p. m. Fig. 4)

At 2 p. m. the *Lutzow* bore about 85°, distant 29 miles from the *Lion*, Admiral Beatty's flagship.

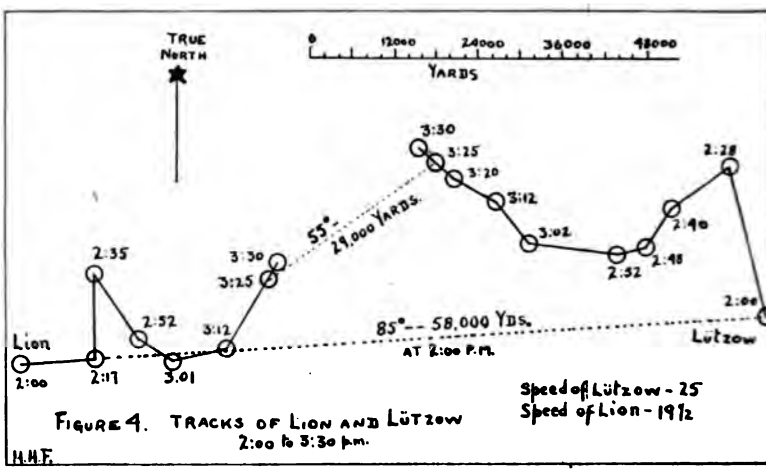


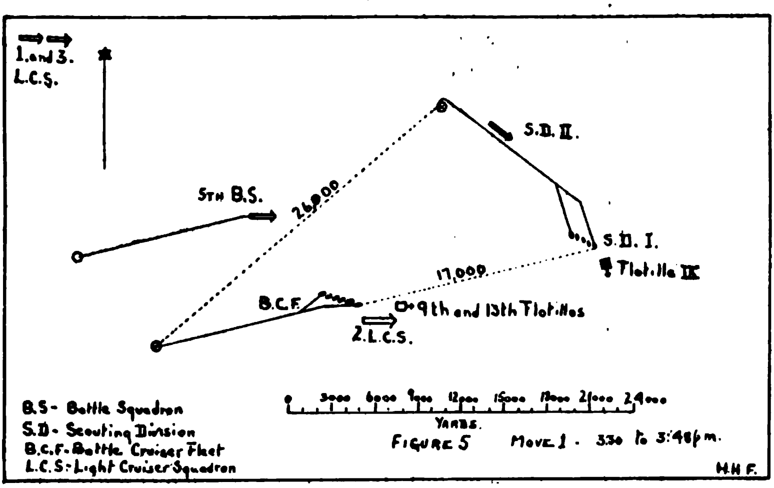
FIGURE 4. TRACKS OF LION AND LÜTZOW 2:00 to 3:30 p.m.

At 2.20 p. m. the *Elbing*, which had proceeded to the westward to examine a neutral steamer, sighted the British light cruiser *Galatea*. As 2.28 Hipper and Scheer received a report from *B-109* that eight British light cruisers were in sight. Admiral Hipper immediately went ships left about 110° with Scouting Division I and steadied on course about 235°. Admiral Bödicker assembled Scouting Division II and proceeded toward the British light cruisers.

At 2.40 Hipper changed course to about 215°, at 2.48 to about 258° and at 2.52 to about 276°.

At 3.00 the light cruiser *Elbing* was seen engaging British light cruisers at long range and at 3.02 Scouting Division I formed column on course about 320°. At 3.12 course was altered in succession to about 300°; at 3.20 Admiral Hipper sighted two columns of British battle cruisers, which soon were seen forming one column of six ships. Apparently the four battleships of the Fifth Battle Squadron were not sighted. At 3.25, according to the British sketch, the German battle cruisers bore about 55°, distant about 29,000 yards. Admiral Hipper recalled Scouting Division II. At 3.30 the range was about 26,000 yards and rapidly decreasing.

VI. MOVE I. THE DEPLOYMENT
(3.30 to 3.48 p. m. Fig. 5)



At about 3.30 the *Lutzow* countermarched, followed by the other battle cruisers, and steadied on course about 128°. Scouting Division II headed toward the *Lutzow* and Flotilla IX took station in the van. At 3.45 Scouting Division I went ships right about 40° and steadied in line of bearing formation on course about 165°. At the same time, Beatty changed course to 98° and formed his six battle cruisers on a line of bearing. On each side the speed was 25 knots; as the two forces were converging at an angle of about 67° the range was decreasing rapidly.

At 3.35 Admiral Scheer first received word that heavy British forces had been sighted; he immediately reduced the distance between ships to 500 meters and the interval between squadrons was decreased to 1000 meters; orders to clear for action were sent out.

In the battle cruiser action about to commence, it was at first a difficult task to reconcile the ranges given by the British and the Germans; in order to attempt this the track of the British battle cruisers was drawn on a piece of thin paper, while that of the German battle cruisers was drawn on another; by moving one of these over the other a situation was finally discovered which gave ranges approximating very closely those given by all accounts; the only remaining important discrepancy is that of the opening range at 3.48 p. m. Admiral Scheer gives the range at 3.49 as about 14,500 yards; as the rate of change was about 1000 yards a minute, this would give 15,500 yards at 3.48; at this last time the gunnery officer of the *Derfflinger* states that his range to the *Princess Royal* was 16,400 yards; the British range was 18,500 yards. These differences could be caused by a mistake in noting the time by three minutes or a difference in the British and German times of that amount; they might also be caused by the fact that the British range was measured between two particular ships, while the German range was taken between two other ships.

VII. MOVE II. THE BATTLE CRUISER ACTION

(3.48 to 4.08 p. m. Fig. 6)

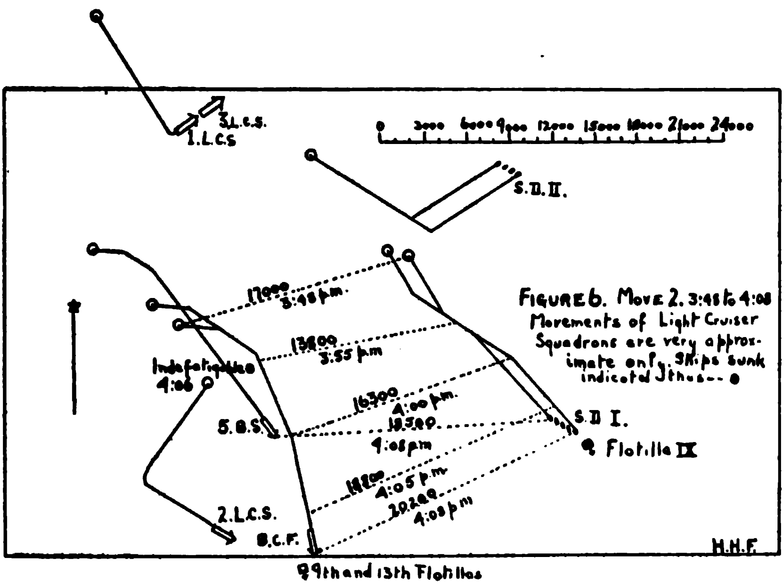
At 3.48 the battle cruiser fleet and Scouting Division I opened fire at about 17,000 yards; the Germans commenced with four gun salvos from their main batteries; in accordance with Admiral Hipper's order, "Fire distribution from the left," the *Lutzow* fired at the *Lion*, the *Derfflinger* at the *Princess Royal*, the *Seydlitz* at the *Queen Mary*, the *Moltke* at the *Tiger* and the *Von der Tann* at the *New Zealand;* the *Indefatigable*, last ship in the British column, was not under fire.

At 3.51 the *Lutzow* scored the first hit, two of her shells hitting the *Lion*. Just at this time Beatty went into column on a southeasterly course.

As an illustration of the German methods of fire control the workings of the *Derfflinger's* system in the first minutes of the

action will be described. At 3.30, when the Germans were expecting to open fire on British light cruisers, the following order was given: "Our light cruisers have opened fire. Train on the second light cruiser from the right. Load with shell and half-cock. Point of aim: right edge, waterline. Deflection 20 left, 18,600 yards."

After British battle cruisers were sighted and the turn to the southward was made, the following order was issued: "5.35. Ship turning to starboard. Change over switches for action on



starboard side in normal positions; 18,600 yards; 18,000 yards. Heavy guns armor-piercing shell. Train on second battle cruiser from left, 102°; Speed of ship 26 knots, course ESE.; 18,600 yards. Deflection left 10. Rate 100 closing; 17,900 yards."

At 3.48, just as a range of 16,400 yards was being put on the sights, the *Lutzow* let go a salvo and hoisted the signal to commence firing. Immediately the following order was sent out from the fire control tower: "Ship turning to starboard; rate 200 closing, 16,400 yards; salvo, fire!"

The salvo clocks sounded after an interval of 30 seconds; the salvo was well bunched, but over and to the right; the spot was "left 2; down 400." The second salvo was also over, and the

spot was "down 400" a second time. The third salvo being still over, a spot of "down 800" was ordered, but, due to a mistake in communications, this spot was not put on the sights until after the fifth salvo had been fired; then the mistake was discovered and the sixth salvo was a straddle. Four minutes had been consumed in getting on and six salvos, at about 40-second intervals, had been used without getting a hit. The reasons for this poor work were two:

1. The rate of change was much too small; in four minutes the sightbar range had decreased by 3,400 yards, or 850 yards a minute; the rate of change put on the clock was only two hundred meters a minute.

2. The failure of the rangefinder operators in the first few minutes. "The rangetakers," says von Hase, "were disconcerted at the first sight of the hostile mastodons. Each saw the enemy ship through his instrument 23 times enlarged. Their thoughts were concentrated on the appearance of the enemy, and they worried themselves trying to identify him. Therefore, when the order to open fire was suddenly given, they had not quite determined the range." Later the rangefinder readings were so accurate that no one varied from each of the others by more than 300 meters.

As soon as the first straddle was made, the order, "Good, rapid; hitting" was given. Four-gun salvos of the main battery were then given at 20-second intervals. Between each two of these salvos, two seven-gun salvos of the secondary battery were fired; thus there was a salvo fired at intervals of about 7 seconds. This fire was kept up for several minutes; then the smoke clouds from the guns and the difficulty of separating the splashes of the main and secondary batteries made it necessary to cease fire with the secondary battery; the 20-second salvos from the main battery were continued; the fire of the secondary battery was used for short intervals throughout the battle when the range was comparatively short and it had been exactly determined.

At 3.52 the *Moltke* made her first hit on the *Tiger;* at 5.53 Scouting Division I went ships left about 45° and steadied on course about 120°; by this time the range had decreased to about 13,500 yards; now it commenced to increase gradually. At 3.54 Beatty changed course away to about 158° and the range then increased very rapidly, as the opposing battle cruisers were diverging about 38°.

At 3.55 the range was about 13,800; the *Moltke* landed hits on two of the *Tiger's* turrets; at this time the *Derfflinger* made her

first hit on the *Princess Royal* forward; by this time it had received at least one hit from the *Princess Royal;* by 4.00 the *Lion* had received several more hits, one shell blowing off the top of a turret. The range at this time was about 16,500 yards. Beatty now turned away again to a course of about 168°, but the Germans went ships right to about course 135°, forming a line of bearing; the range continued to increase as the forces were still diverging by about 35°.

At 4 Scouting Division II turned together to about 55° to escape from the Fifth Battle Squadron and was therefore unable to take position as ordered ahead of Scouting Division I.

At 4.05 the range was 18,000 yards and at 4.08 it was no less than 20,200. At about 4.06 the *Derfflinger* ceased fire, as the guns had reached their extreme elevation, 19,700 yards. After originally opening fire on the *New Zealand,* the *Von der Tann* had shifted target to the *Indefatigable;* at 4.06 that ship was hit by a salvo and blew up. At this time the *Von der Tann's* range was probably over 19,000 yards.

At about 3.45 Admiral Scheer had received news that Hipper was about to engage six British battle cruisers. At 4.05 the battle fleet changed course to the northwest and increased speed to 15 knots.

VIII. MOVE III. THE FIFTH BATTLE SQUADRON ENTERS THE ACTION

(4.08 to 4.30 p. m. Fig. 7)

At 4.08 the Fifth Battle Squadron of four ships opened fire on the rear ships of Scouting Division I at a range of about 18,500 yards between the *Barham* and the *Von der Tann.*

At 4.10 Scouting Division I went ships right about 40° to course 175°; at 4.12 Beatty changed course toward the Germans and steadied on 130°; at 4.12 the range was 21,000 yards, but with the courses of the opposing forces converging by 45° it began to decrease rapidly; the fire of both British and German battle cruisers had practically ceased.

At about 4.10 twelve British destroyers, led by Commander Bingham in the *Nestor,* increased speed to 35 knots to gain a favorable position for a torpedo attack. The fire of the Fifth Battle Squadron became more effective as its range at 4.20 had

decreased to about 17,000 yards. "This," says Scheer, "made the situation critical for our cruisers. The new enemy fired with extraordinary rapidity and accuracy, with the greater ease as regards the latter that he met with almost no opposition, as our battle cruisers were fully engaged with Admiral Beatty's ships."

For this reason, at about 4.15 Captain Goehle of Flotilla IX prepared on his own initiative an attack; the *Regensburg* and the

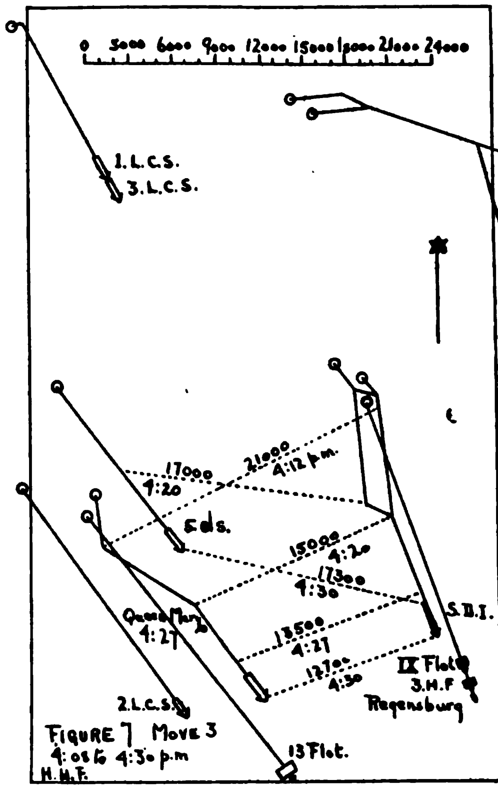


FIGURE 7 Move 3
4:08 to 4:30 p.m
H.H.F.

Third Half Flotilla joined him in gaining a favorable position ahead of the battle cruisers.

At about 4.12 Scouting Division II had formed column on course 110°. At 4.20 it went ships right about 55° to course 165°. In order to escape from the Fifth Battle Squadron it had been compelled to make such a detour as to prevent it from gaining the assigned position ahead of the battle cruisers, where their support would have been invaluable for the destroyer attack.

At about 4.17 the German battle cruisers of Scouting Division I opened fire again; this time the *Derfflinger* selected the *Queen Mary* as a target; the fire of the other ships was probably distributed as follows:

Lutzow on *Lion* or *Princess Royal.*
Seydlitz on *Tiger.*
Moltke on *New Zealand.*
Von der Tann on *Barham,* the leader of the Fifth Battle Squadron.

At 4.20 the range between the battle cruisers was about 15,000 yards, and between the *Von der Tann* and *Barham* about 17,000. As both these ranges were decreasing very rapidly, Hipper went ships left into column and steadied on about 162°. At the same time Beatty changed course to about 147°. Thus, while both British and Germans had made slight changes of course away, the courses were still converging by 15°.

At 4.22 the *Seydlitz* shifted her fire on to the *Queen Mary,* thus putting her under the heavy fire of two ships; the splash clocks allowed the *Derfflinger's* spotters to distinguish their splashes from those of the *Seydlitz* and there was no difficulty of controlling the fire; the *Queen Mary* at this time was firing very well bunched eight-gun salvos, but the *Derfflinger* was hit by only two shells.

The gunnery diary of the *Derfflinger* forms a most interesting record:

Time	Bearing	Range in hectometers	Deflection	Remarks
6:22	52	140	10 Left	Rate 300 closing.
6:22:40	51	139	16	Up 200
6:23:45	52	137	14	Up 100
6:24:20	52	135	14	Good, Rapid!
6:24:40	52	134	14	
6:25	52	134	14	
6:25:20	52	132	14	
6:25:45	52	131	14	
6:26:10	52	132	10	Up 200; great explosion in enemy ship. Shift target to second battle-cruiser from the left.

The six last salvos of the *Derfflinger* had hit the *Queen Mary;* on at least one occasion all four shots of the salvo hit. Commander von Hase describes her destruction as follows: "The historic moment at which the *Queen Mary* sank was about 6.26

p. m. From 6.24 onward each of our salvos had landed in the ship. The salvo fired at 6.26 fell when violent explosions in the interior of the *Queen Mary* had already begun. At first a dazzling red flame leaped up from the forward part of the ship. Then an explosion took place in the same position, followed by one of much greater violence amidships; black débris flew aloft, and immediately afterwards the entire ship blazed up in one entire explosion. A gigantic cloud of smoke formed, the masts collapsed toward the center of the ship, and the smoke, rising ever higher, blotted out everything from sight."

It will be noted that the bearing of the target and the deflection during the period from 4.24 to 4.26 were absolutely constant; the rate of change was also small, only 200 meters a minute.

At 4.27 the range between the battle cruisers was about 13,500 yards. At 4.30 it had decreased to 12,700; that from the *Von der Tann* to the *Barham* was about 17,300. At 4.23 the latter ship had received her first hit, presumably from the *Von der Tann*; at 4.26 the *New Zealand* had received her first and only hit, probably from the *Moltke*.

At 4.20 Admiral Scheer changed the course of the battle fleet to the west and went 15 knots; his object was to catch the battle cruiser fleet between the battle fleet and Scouting Division I. Just as he was changing course, a despatch was received from Scouting Division II to the effect that a fresh squadron of five battleships was engaging Hipper. Scheer then decided that he must come to the assistance of Hipper at the earliest possible moment and therefore headed north again; at 4.30 he sighted the German battle cruisers.

IX. MOVE IV. THE DESTROYER ACTION

(4.30 to 4.45 p. m. Fig. 8)

Shortly after 4.30 the twelve British destroyers, having gained a favorable position for attack, turned in single column to the northeast toward the German battle cruisers. At the same time the fifteen German destroyers advanced to meet them, supported by the *Regensburg*. The British destroyers opened fire at 10,000 range with their 4-inch guns; within a few minutes the range had decreased to about 2000 yards and a very sharp action took place; the German destroyers were much smaller and lighter armed;

V-27 and *V-29* were sunk; their crews were rescued by *V-26* and *S-35*. Flotilla IX and the Third Half Flotilla retired after having fired twelve torpedoes at the British battle cruisers at ranges of from 9,000 to 11,000 yards. During the action the *Nomad* was crippled by gunfire, but the remaining British destroyers continued on in pursuit of the retiring German destroyers. The *Nestor* and *Nicator* changed course to the southeastward and fired

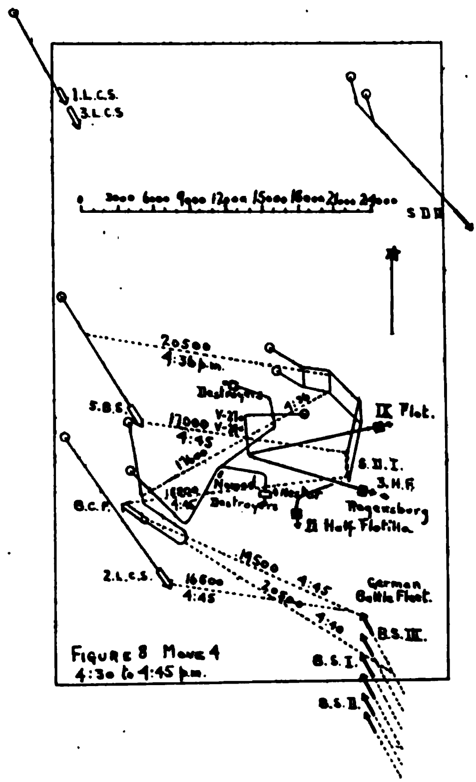


Figure 8 Move 4
4:30 to 4:45 p.m.

torpedoes at the German battle cruisers; the *Nestor* was crippled by a salvo from the *Regensburg;* the remaining British destroyers continued on to the northeast, three of them firing one torpedo each; from about 4.36 on the destroyers came under a very heavy fire from the secondary batteries of the German battle cruisers; in reply the destroyers made many hits with their 4-inch guns. At about 4.45 the 11th Half Flotilla, led by Captain Max Schultz in *G-41*, the flagboat of Flotilla VI, advanced to the attack.

At 4.30 Admiral Hipper went ships left 42° and steadied on course about 120° in a line of bearing formation. This sharp turn away was made either to avoid the British destroyers, which had reached a favorable position from which to commence a torpedo attack, or to open the range, so as to decrease the effect of the British fire until he could receive the support of the German battle fleet. At 4.33 an additional change away was made. At 4.36 the range to the British battle cruisers was about 17,600, while that to the Fifth Battle Squadron was about 20,500 yards. The *Derfflinger*, which after the sinking of the *Queen Mary* had been firing at the *Princess Royal*, now ceased firing.

At 4.36 course was changed toward the British and at 4.40 a further change was made, Scouting Division I steadying in about 2-point line of bearing on course 192°.

At 4.37 Beatty changed to about 127° in an attempt to close the range, but at 4.42, sighting the German Battle Fleet, he countermarched to starboard. He does not appear to have been under fire during the turn. By 4.45 it had been completed; the *Lion* was distant about 18,800 yards from the *Lutzow* and the *New Zealand* about 19,500 yards from the *Konig*, the leading vessel of the battle fleet. At 4.45 Battle Squadrons III and I opened fire at about 16,500 yards range on the Second Light Cruiser Squadron, which was coming on at full speed on a southeasterly course.

During this period Scouting Division II kept on to the southeastward.

X. MOVE V. THE GERMAN BATTLE FLEET ENTERS THE ACTION

(4.45 to 5 p. m. Fig. 9)

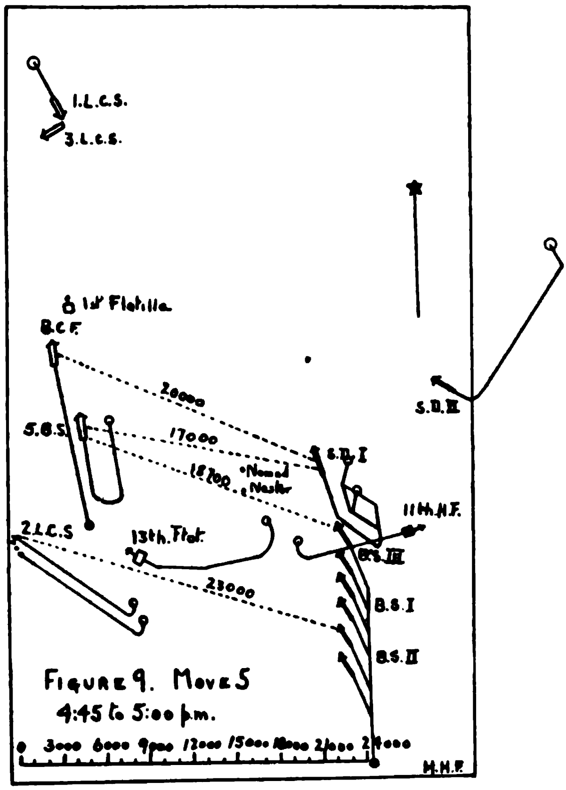
At 4.45 the *Derfflinger* opened fire on the *Princess Royal* at about 18,800 yards and continued for eight salvos. At about 4.50 Admiral Hipper formed column and countermarched to starboard and steadied on course about 343°.

At about 4.57 the Fifth Battle Squadron countermarched to starboard and took station astern of the battle cruiser fleet.

From 4.45 on the leading German battleships were firing on the Second Light Cruiser Squadron; when the range decreased to about 13,000 yards the light cruisers went ships right about 12 points and steadied on a northwesterly course; just as they were getting out of range, without having received a single hit,

the Fifth Battle Squadron was seen turning and these ships became the target of the leading German battleships at about 18,700 yards range. It is improbable that any hits were made.

At 4.59 the *Derfflinger* was firing at the battle cruisers at a range of about 20,000 yards. Probably the rear German battle cruisers were firing at the Fifth Battle Squadron at about 17,000 yards range.

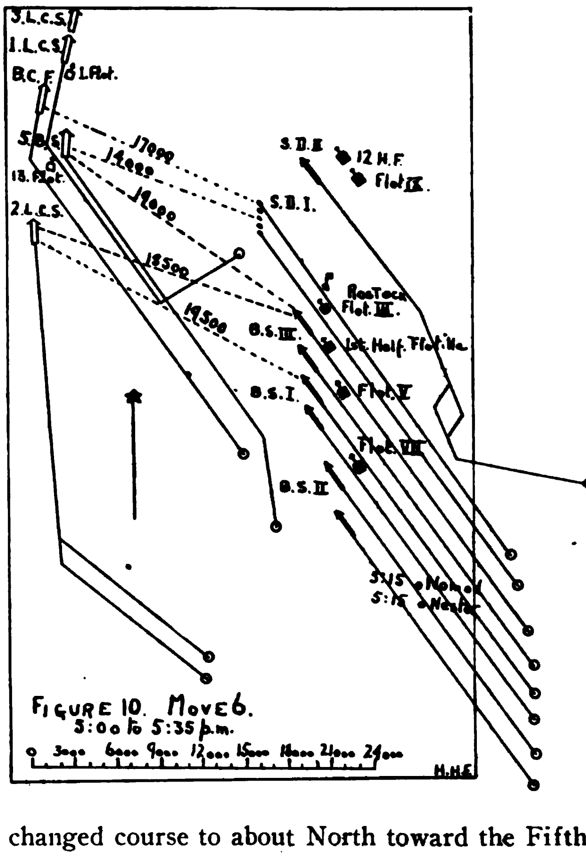


At about 4.49 the 11th Half Flotilla fired torpedoes and withdrew. At the end of this move Scouting Division II was in column to the northeast of Scouting Division I and had turned to the northwest to take its assigned position ahead of the battle cruisers. This division seems to have been in inverted order, with the *Wiesbaden* leading, and the *Frankfurt*, the flagship, last.

XI. MOVE VI. THE RUN TO THE NORTH

(5 to 5.35 p. m. Fig. 10)

At 5 Beatty turned away to course 325° in order to increase the range; the Fifth Battle Squadron followed the battle cruiser fleet; the Second Light Cruiser Squadron continued on its north-westerly course until about 5.15, when, being practically out of



range, it changed course to about North toward the Fifth Battle Squadron.

At 5 Scouting Division I went ships left about 18° from column to a course of about 325°. The leading ships fired at the battle cruiser fleet at ranges of about 20,000 yards; the rear ships probably fired at the Fifth Battle Squadron at about 17,000 yards range.

At 5 the battle fleet was proceeding in line of divisions on course about 325°. The fleet speed was 20 knots. Battle Squadron III was exceeding the speed in order to reduce the range to the Fifth Battle Squadron, but as this unit was able to make at least 24 knots, it rapidly drew ahead. After 5.00 p. m. only Division Five, containing the four ships of the *Konig* class, was able to fire on the British battleships at the extreme range of about 19,000 yards; the other battleships fired on the Second Light Cruiser Squadron.

As early as 5.12 the battle cruiser fleet lost sight of the German battle cruisers and ceased fire; at about 5.21 Admiral Hipper received orders "to give chase" to the British battle cruisers, but as by this time the latter were fast disappearing to the northward, the German battle cruisers shifted their fire onto the Fifth Battle Squadron at a range of about 14,000 yards; as the visibility had now become poor very few hits could have been made by either Germans or British. The *Derfflinger* received two or three hits during the run to the northward. The wind had shifted from the northwest to the southwest; only at intervals could Scheer see his scouting divisions ahead.

At about 5.15 the German Battle Fleet sank the *Nestor* and *Nomad,* German destroyers saving their crews.

At 5.30 Beatty changed course to the right, steadying on 15°. At 5.35 the range from Beatty to Hipper was about 17,000 yards; from Evan-Thomas, in the Fifth Battle Squadron, to Hipper about 14,000 yards and to Behncke, in the *Konig,* about 19,000 yards; from Goodenough, in the Second Light Cruiser Squadron, to Scheer about 19,000 yards.

XI. MOVE VII. ENGAGEMENTS BETWEEN THE LIGHT FORCES (5.35 to 5.55 p. m. Fig. 11)

At about 5.36 the light cruisers of Scouting Division II sighted a British light cruiser to the northeast; this was the *Chester,* attached to the Third Battle Cruiser Squadron; a short engagement at 6000 yards range ensued and the *Chester* made off to the northeast to gain the support of the Third Battle Cruiser Squadron, which had turned to northwest at 5.40. At about 5.50 the British cruiser *Defense* fired on Scouting Division II, but her shells fell so far short that the Germans never knew they were

under fire or sighted the firing ship; the firing range was apparently about 16,500 yards. At 5.55 the German light cruisers came under the fire of the Third Battle Cruiser Squadron at a range of about 10,000 yards; Admiral Bodicker reported this fact to the commander-in-chief, who assumed that the British Battle Fleet was with the Third Battle Cruiser Squadron and thus formed a completely erroneous idea of the entire tactical situa-

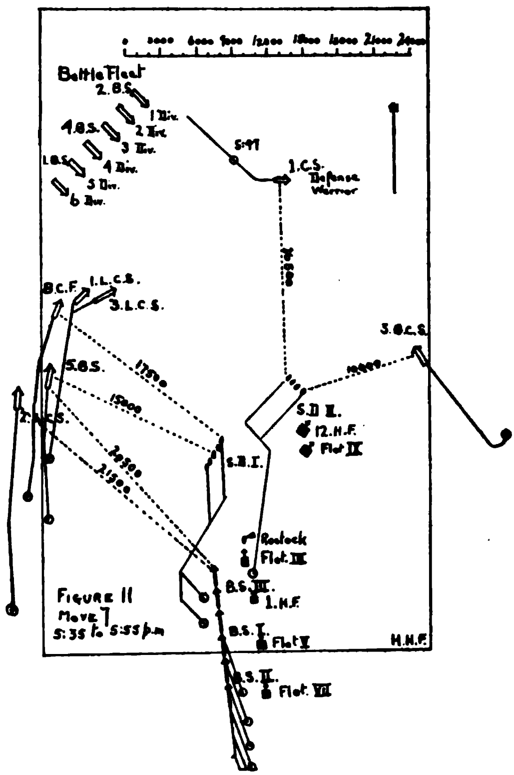


Figure II
Move 7
5:35 to 5:55 p.m.

tion; in judging his subsequent movements, it must be remembered that he believed the British Battle Fleet was to the northeast, when it actually was to the northwest.

At 5.40 Hipper went ships right about 90° and steadied the battle cruisers on a northeasterly course; his reason for this change is that British "light forces began a torpedo attack." No British light cruiser or destroyer attack is reported at this time, but possibly some of the destroyers which were stationed ahead of

the Battle Cruiser Fleet were between the fighting lines in a position which would have been favorable for torpedo attack had Hipper kept on.

At 5.42 Scouting Division I again came under the fire of the battle cruiser fleet. At 5.50 Hipper again changed course to the north, engaging the Fifth Battle Squadron at about 15,000 yards range.

At 5.45 the German Battle Fleet was formed in column on course about 352°; the speed was reduced to 15 knots in order to allow the divisions to regain their proper position.

XII. MOVE VIII. THE MÊLÉE

(5.55 to 6.10 p. m. Fig. 12)

Scouting Division II, which at 5.55 had come under the fire of the Third Battle Cruiser Squadron, kept on for a few minutes, until the range had decreased to about 8000 yards; it was then evident that the four light cruisers of this division were opposed to greatly superior forces; torpedoes were then fired at the British battle cruisers and the division went ships right 90° to form column on a southeasterly course; during the turn the division came under a severe fire "from some newly arrived large ships." These were the *Defense* and *Warrior;* after their first salvos had fallen short, Admiral Arbuthnot had led them directly toward the German light cruisers and then had made additional change to the right to bring their port batteries to bear; at about 6.01 they opened fire at a range of about 12,000 yards; as their well-directed salvos began to fall upon the light cruisers, the Germans spread a screen of artificial smoke to conceal their vessels; nevertheless the *Wiesbaden* was so badly damaged that she lay dead in the water between the lines; the *Pillau* was also badly hit, but was able to remain in formation. After forming column to the southeastward, Scouting Division II changed course in succession to the southwest to gain the support of their battle cruisers.

But at the same time Scouting Division I also felt compelled to draw off. At 5.55 the division went ships right 90° to an easterly course; at 6.00 Admiral Hipper went ships right 90° more to a southerly course, probably to avoid the British destroyer *Onslow,* which from a position near the *Lion* had pushed home a splendid torpedo attack. Having crippled this destroyer and

avoided its attack, Hipper kept right on around the circle and by 6.10 he had passed through northwest and had nearly reached a northeasterly course; after completing the circle Hipper was in column a short distance ahead of the leading battleship division.

As Scouting Divisions I and II withdrew Flotilla IX and the 12th Half Flotilla advanced to the attack to cover their retreat. Gaining a favorable firing position within 6500 yards of the Third Battle Cruiser Squadron, they fired their torpedoes and

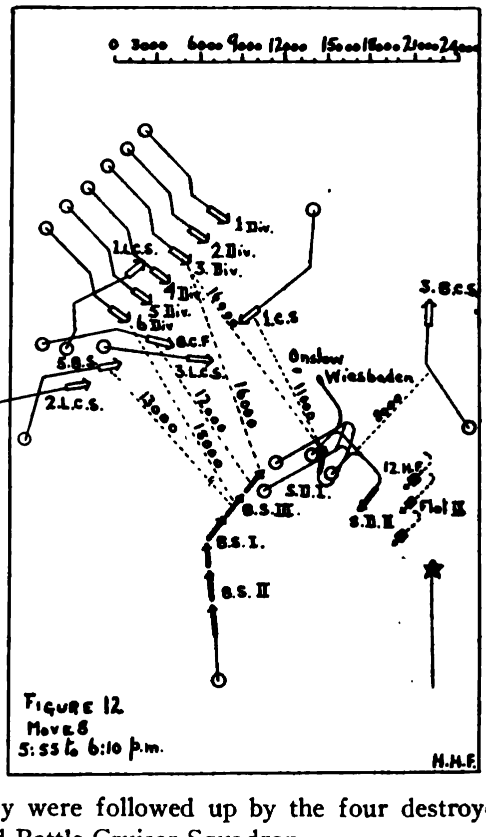


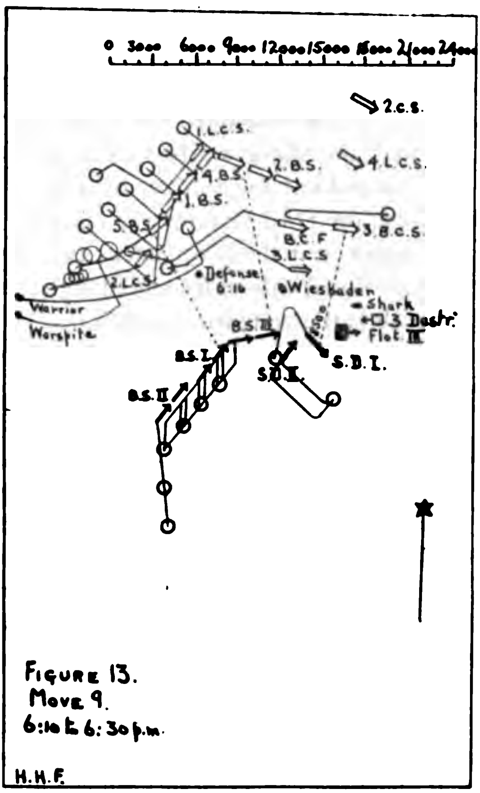
Figure 12
Moves 8
5:55 to 6:10 p.m.

retired; they were followed up by the four destroyers attached to the Third Battle Cruiser Squadron.

Admiral Scheer continued on his northerly course; at about 6.00 course was changed to the northeast by Admiral Behncke in the *Konig* and the other divisions followed. By 6.10 about three divisions had changed to the new course. At about this time a report was received that the *Wiesbaden* had been put out

of action; while the German destroyers which had made the torpedo attack reported a long line of at least 20 British battleships proceeding on a southeasterly course. The mist, smoke from funnels and artificial smoke screens still prevented Scheer from seeing the British Battle Fleet.

XIII. MOVE IX. FIRST ACTION BETWEEN THE BATTLE FLEETS (6.10 to 6.30 p. m. Fig. 13)



At about 6.12 Scouting Division I reached column on a northeasterly course; at about the same time Scheer went ships left two points, probably with his two leading battle squadrons, in order to attempt to save the *Wiesbaden,* but in a few minutes, coming under a very heavy fire, he went back to column again and the leading division changed course away from the British to about 80°, followed by the Second Division. "It was quite ob-

vious," he writes, "that we were confronted by a large portion of the English Fleet and a few minutes later their presence was notified on the horizon directly ahead of us by rounds of firing from guns of heavy caliber. The entire arc stretching from north to east was a sea of fire. The flash from the muzzles of the guns was distinctly seen through the mist and smoke on the horizon, though the ships themselves were not distinguishable."

At 6.15 Scouting Division I came under heavy gunfire, probably from the First Battle Squadron. The division changed course in succession to the eastward. It was again attacked at about this time by the *Onslow,* which fired two torpedoes; in addition, the four destroyers which had accompanied the Third Battle Cruiser Squadron now attacked; the *Shark* was badly crippled; the *Acasta,* after having fired a torpedo at the *Lutzow* at 4500 yards range, retired badly damaged; the *Onslow* now was completely crippled and lay dead in the water near the *Wiesbaden;* this devoted ship, commanded by Captain Reiss, although covered with the gunfire of the two leading British battle squadrons, continued to reply with the few guns still in action and fired all her torpedoes at the British battle line.

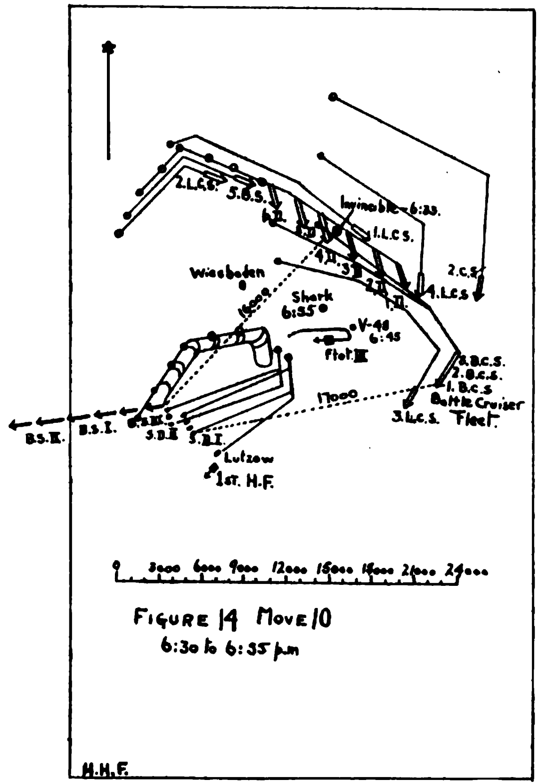
At 6.16 the *Defense* and *Warrior,* which were firing on the *Wiesbaden,* came under heavy fire of the German battle line at 6000 yards range; the *Defense* blew up and the *Warrior,* very badly damaged, was fortunate to be able to make off to the westward; this vessel sank the next morning; at about 6.20 the *Warspite,* of the Fifth Battle Squadron, had her helm jambed hard over by a German shell and came on for the German battle line; she was very heavily hit by the German battleships and made off to the westward, taking no further part in the action.

At 6.22 the Third Battle Cruiser Squadron came into action again at 8000 yards range and fired with great effect on Scouting Division I; by 6.25 the *Lutzow* was very heavily hit and on fire; the Germans were unable to make out the firing ships until 6.30; this shows the great advantage which the British possessed in having more favorable visibility conditions. By 6.30 the German battle cruisers had commenced to turn in succession to the southward.

XIV. MOVE X. THE FIRST GERMAN RETIREMENT

(6.30 to 6.55 p. m. Fig. 14)

The situation was now exceedingly critical for the Germans; but it seemed to Scheer more critical than it really was because he considered the British Battle Fleet was more to the right, and



consequently more nearly ahead, than it actually was. In a rapid survey he made the following estimate:

1. The German cruisers were out of sight ahead, so that if the battle fleet turned to the southward in succession they would find themselves between the two battle lines.

2. British ships firing on the pivot of the battle line, if a change of course in succession to the southward were made, would have the advantage of enfilade fire; that is, they would be firing down a line of German ships, so that shells over or short of the target would have a good chance of hitting other ships in the line.

3. In the case of a parallel fight on a southerly course, the British would have the advantage of better visibility conditions.

For these reasons he ordered a remarkable maneuver, "Ships right about." At the time the signal was made the battle fleet was in a most unfavorable position for such a difficult maneuver carried on under the heaviest gunfire. The leading division was heading to the southward; the next three divisions were steering about east; the last two divisions were on course about northeast; the long column of 22 ships had one angle of 90° and another of 45° in it; the turn had to be made to the right, which would tend to throw the ships into a shorter line than that they had occupied originally; nevertheless, despite these extraordinary difficulties, the maneuver succeeded. "The swing round," says Scheer, "was carried out in excellent style. At our peace maneuvers great importance was always attached to their being carried out on a curved line and every means employed to ensure the working of the signals. The trouble spent was now well repaid."

At 6.30 Scouting Division I sighted the *Invincible,* leading the Third Battle Cruiser Squadron; the *Derfflinger* immediately opened fire on the *Invincible* at about 8500 yards. Four successive salvos hit and at 6.33 it blew up; during this brief action the *Derfflinger* had received three hits, which put two 6-inch guns out of action. Commander von Hase gives the following animated account of this part of the battle:

Suddenly, however, we came under a heavy and well-aimed fire from several ships simultaneously. It was evident that the enemy could now see us much better than we could see him. Several heavy projectiles crashed into the ship, exploding with a mighty roar. The hull trembled beneath the impact, and the captain frequently turned away to escape the hurricane of shell. This made it difficult to control the fire. . . . . At this moment the curtain of fog suddenly lifted, revealing a clear horizon on the port beam. There, sharply silhouetted against the light, was a large dreadnought. She was steaming at full speed on a course parallel with ours. Her guns were trained upon us, and another salvo blazed out, straddling us completely. "Range 90 hundred," shouted my rangetaker; "90 hundred, salvo, fire!" I ordered, and waited for the splash with feverish anxiety. "Over, two hits," came the message from the foretop. "Down 100. Good, rapid!" was my next order, and thirty seconds after my first salvo, another was fired. I observed two hits and two shorts. Salvos were now fired every 20 seconds. The *Derfflinger's* last salvo was discharged at 8.31 p.m., and then, for the third time, we saw the appalling sight that we had witnessed in the case of the *Queen Mary* and the *Defense*—a succession of tremendous explosions, masts collapsing, and débris soaring aloft. A huge pillar of smoke ascended, flames played about the ship, and our enemy disappeared in a black cloud of smoke and coal dust. I called through the

telephone, "Our opponent has blown up!" and heard the cheering that broke out.

When the German Battle Fleet turned to the westward, Scouting Divisions I and II followed; as these divisions were already headed south when the signal was received, they probably went ships right 90° and stood off to the westward in line 90. The *Lutzow* now fell out of formation; she had been hit shortly after 6.30 p. m. by a torpedo in the bows; at least 15 heavy shells had hit her and as many as 60 hits of all caliber have been reported in unofficial accounts. The 1st Half Flotilla and a few other boats accompanied her out of the action. At about the same time the *Seydlitz* was also hit by a torpedo in line with the foremast. These two torpedo hits were scored by the *Onslow,* the *Acasta* or the Third Light Cruiser Squadron, which had pushed in to about 7000 yards range and opened fire with guns and torpedoes.

When the battle fleet turned to the rear, Flotilla III advanced inside the lines and laid a screen of artificial smoke to conceal the movement; the flotilla was then recalled by the first leader of the destroyer forces; nevertheless, two boats of the flotilla, *G-88* and *V-73,* and the flagboat of Flotilla I, *S-32,* advanced to within 7000 yards of the British formation and fired six torpedoes; it was probably one of these torpedoes which hit the *Marlborough* at 6.45. During the advance of the flotilla *V-48* was sunk. The boats of this flotilla probably sank the *Shark* at about 6.55 after a most gallant and desperate defense.

The German forces continued on to the westward until 6.55 p. m.; during this period they were practically out of range.

The *Wiesbaden* continued her splendid fight with but one gun left in action. Despite the fact that this vessel was under the short range fire of practically the entire British Battle Fleet, and that she was torpedoed by the *Onslow,* she did not sink until the next morning; only one man of the crew was rescued.

At 6.50 Admiral Hipper left the *Lutzow* and boarded a destroyer; he first hailed the *Derfflinger,* but as she could not send radio messages she could not be used as a flagship; the *Seydlitz* had her radio completely destroyed; Hipper was forced to remain in the destroyer until 9.00 p. m. Until that time Captain Hartog of the *Derfflinger* commanded the division; at 9.00 Hipper boarded the *Moltke.*

XV. MOVE XI. THE SECOND ACTION BETWEEN THE BATTLE FLEETS

(6.55 to 7.15 p. m. Fig. 15)

At 6.55 the High Sea Fleet was disengaged from its far superior foe. All the German ships, except the *Lutzow* and the *Wiesbaden,* were in formation, although the battle cruisers and Division Five,

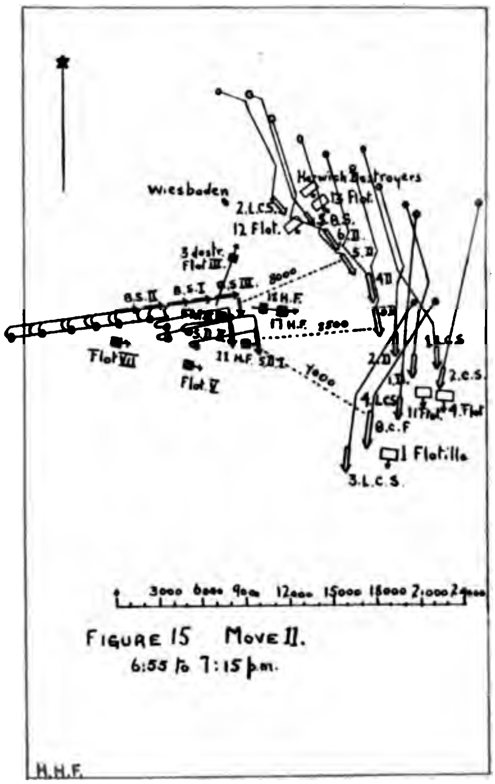


FIGURE 15 Move 11.
6:55 to 7:15 p.m.

at the head of the battle fleet, had suffered somewhat severely. Scheer then made the following estimate:

1. It was still too early for a night move; the Grand Fleet had still two more hours of daylight in which to force the fighting.

2. If he kept on his present course it would have an adverse effect upon the morale of his crews, because it would be regarded as a retreat.

3. If the Grand Fleet followed his retirement, all his disabled ships, including the *Lutzow* and *Wiesbaden,* would be lost, due to their reduced speed.

4. The British destroyers had been used hardly at all in the day action, and Scheer feared the effect of their attacks during darkness; he wished them to attack and expend their torpedoes during daylight, when the splendid maneuvering ability of his fleet would allow him to avoid them.

5. Even if he should be able to avoid the Grand Fleet for the rest of the day and even the night in addition, the British would still be able to engage him the next morning.

For the reasons Scheer came to a startling decision, namely:

To force the enemy into a second battle by another determined advance, and forcibly compel his destroyers to attack. The success of the turning of the line while fighting encouraged me to make the attempt, and decided me to make still further use of the facility of movement. The maneuver would be bound to surprise the enemy, to upset his plans for the rest of the day, and if the blow fell heavily it would facilitate the breaking loose at night. The fight of the *Wiesbaden* helped also to strengthen my resolve to make an effort to render assistance to her and at least save the crew.

Therefore at 6.55 the battle fleet executed the signal, "Ships right about." Scouting Divisions I and II received orders to attack the head of the British column; all the flotillas were instructed to attack; Commodore Michelsen was ordered to send destroyers to rescue the crew of the *Wiesbaden;* the scouting divisions probably went ships right about and proceeded in line formation on an easterly course, somewhat in advance of the battle fleet.

At about 7.05 the High Sea Fleet again came under a very heavy fire from the Grand Fleet, which was disposed in a semicircle directly ahead of it; Scouting Division I and Division V began to suffer severely; the 17th Half Flotilla dashed out to attack the center of the British battle line and at 7.15 were within 7000 yards of it; the 18th Half Flotilla probably followed the 17th, although it is not shown on Admiral Scheer's sketch. The 11th Half Flotilla was in position at 7.15, near Scouting Division I, about to commence its attack. Flotillas III and V were in second line. Three boats of Flotilla III were advancing under a very heavy fire toward the *Wiesbaden.*

At 7.12 Admiral Scheer signalled to Captain Hartog, now commanding Scouting Division I from the *Derfflinger,* "At the enemy." At 7.13 the battle cruisers proceeded under a terrific fire to the southeast, shifting at 7.15 to the south. The range from them to the British battle cruisers was about 9000 yards, and only about 8500 to the *Iron Duke.*

At about 7.12 the fire on the head of the German Battle Fleet had become extremely heavy and effective; the *Konig, Grosser Kurfurst* and *Markgraf* received numerous hits from projectiles of the heaviest caliber. Admiral Behncke, in the *Konig,* therefore turned to the south, followed by the other ships of his division in succession.

The battle had now reached its most critical stage; the fates of empires hung in the balance.

XVI. MOVE XII. THE SECOND RETIREMENT OF THE GERMAN BATTLE FLEET

(7.15 to 7.30 p. m. Fig. 16)

Admiral Scheer saw that conditions were becoming unbearable: by 7.17 all the seven ships of Battle Squadron III were heading south and the *Friedrich der Grosse* was at the pivot; the signal for ships right about was then successfully executed by the entire battle fleet; the fleet flagship, in order to give more room at the pivot, went left about; a long column was formed in inverted order on course about 260°.

Scouting Divisions I and II continued on to the southward to cover the retreat of the battle fleet; the battle cruisers were terribly battered; the *Derfflinger* at the head of the line, and the *Seydlitz,* second ship, came under a perfect deluge of fire and were literally shot to pieces. On the *Seydlitz* one gun of No. 2 turret was put out of action, as was one gun of No. 3 turret; No. 4 turret was completely put out of action; No. 5 turret was hit on the top, but continued to fire.

Commander von Hase thus describes the fearful punishment the *Derfflinger* received:

I was still firing with all four turrets when, at 9.13, a terrible disaster occurred. A 15-inch shell pierced the turret armor of C turret and exploded inside. The gallant turret captain, Lieutenant von Boltenstern, had both legs torn away, and with him perished practically the entire guns' crew. In the turret itself one main and one secondary cartridge were set on fire by splinters. The flames penetrated to the working chamber, where two main and two secondary cartridges were ignited on each side, and thence to the handling room, where again two main and two secondary cartridges caught fire. They emitted great tongues of flame, which roared through and above the turret to the height of a house. Of the 78 men composing the turret crew only five managed to escape. . . . . A few moments afterwards a second catastrophe overtook us. A 15-inch projectile

hit and penetrated the roof of D turret and burst in the interior. With the exception of one man, who was blown through the hatch by the blast of air, the entire turret crew, including all the magazine parties—80 men in all—were instantly killed. Here, also, the flames found their way right down to the handling room, setting fire to all the secondary cartridges, which had been removed from their metal holders, and some main cartridges as well.

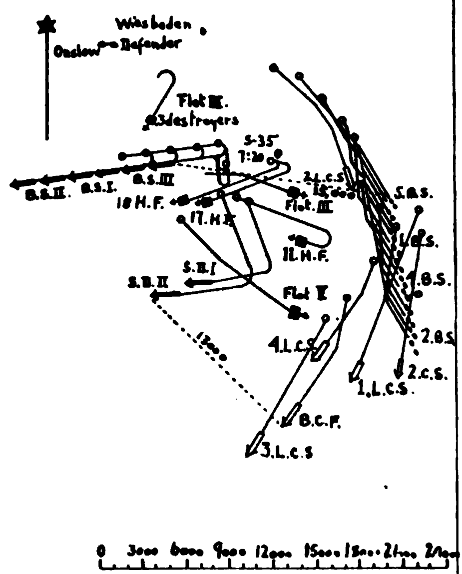


Figure 16. Move 12.
7:15 to 7:30 p.m.

Both after turrets were now vomiting huge flames, mingled with yellow smoke—two dreadful funeral torches. The enemy was shooting splendidly. My heart stood still as I thought of what must be hapening inside the ship. My thoughts were rudely interrupted. Suddenly it was for us as if the world had come to an end. A tremendous roar, a mighty detonation, and then darkness fell upon us. We felt a terrific blow; the whole conning tower, which reeled as if shaken in a giant's grip, was thrown upwards, and then settled down vibrating on its base. The explosion had burst open and jambed the armored door, and two men vainly strove to close it. A moment later another 15-inch shell exploded beneath the bridge. The chart-house disappeared bodily, and the blast of air slammed the door of

the conning tower to. Practically nothing could be seen of the British ships from the *Derfflinger,* though their position was revealed by the great golden-red flashes from the guns.

I could feel how our fire was soothing the nerves of our crew. If we had not fired at this moment the entire company of the ship would have given way to profound despair, for they realized that if things went on like this much longer we should be lost. *But so long as we were firing there must be hope.* The secondary armament also joined in, though only two guns on this side were in action.

At 7.18 Admiral Scheer, having commenced the turn of the battle fleet, ordered Scouting Division I to withdraw; course was changed to about 260°; during the turn the *Derfflinger* fired a torpedo at 9000 yards; at 7.20 the smoke from the burning *Lutzow* hid the ships from the British line; the British Battle Fleet had practically ceased fire; the battle cruiser fleet continued firing at increasing ranges.

At 7.15 numerous German destroyers had been advancing toward the British Battle Fleet; by about 7.20 the 17th and 18th Half Flotillas had reached a position about 6500 yards from the British battle line; they then fired a large number of torpedoes and turned away; despite the very heavy fire which covered them, only *S-35* was lost; this boat was hit amidships and sank at once.

At about 7.17 the 11th Half Flotilla advanced through the German battle cruisers and pushed home an attack to within about 6000 yards of the British battle line; then torpedoes were fired and the boats withdrew without loss.

At a little after 7.20 the three boats of Flotilla III, which were advancing toward the *Wiesbaden,* were compelled to withdraw by the very heavy fire which covered them; four torpedoes were fired by *V-73* and *G-88* at the Fifth Battle Squadron. All the destroyers, as they withdrew, laid dense screens of artificial smoke.

At 7.23 Jellicoe, as a result of these attacks, turned the battle fleet away, first two points and then two more, continuing off until 7.33. At this time the torpedoes fired by the German destroyers passed through his line, and threw its rear into considerable disorder as individual ships maneuvered to avoid them; 11 torpedoes passed near the ships of the battle fleet, while the four torpedoes fired by the *V-73* and *G-88* were seen close to the *Barham* of the Fifth Battle Squadron.

The crisis of the action had passed; the High Sea Fleet had withdrawn from seemingly certain destruction.

XVII. MOVE XIII. GERMAN DESTROYER ATTACKS
(7.30 to 8 p. m. Fig. 17)

The German Battle Fleet continued on to the westward, but soon changed to the southwest and the south; the exact times at which these changes of course were made is not stated, so that the movements shown in Fig. 17 must be accepted with caution.

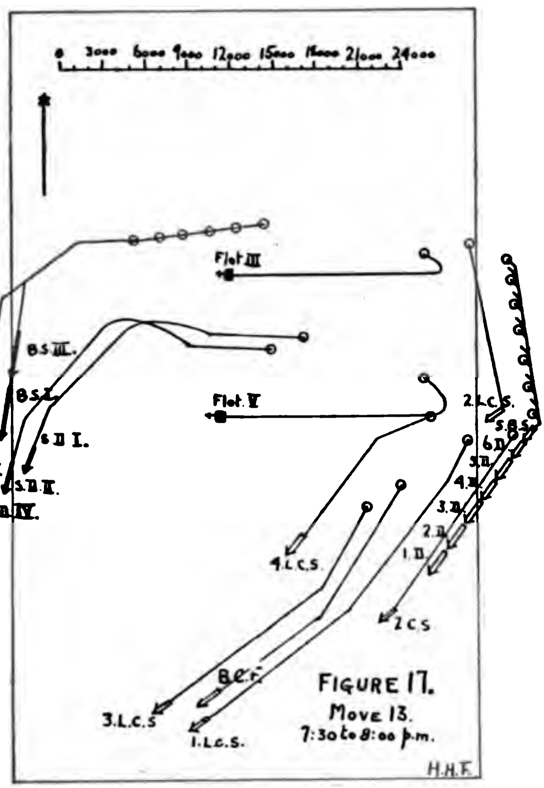


FIGURE 17.
Move 13.
7:30 to 8:00 p.m.

At about 7.30 Scheer sighted the *Lutzow* on the port beam of the flagship; this badly damaged ship reported that she could still make 15 knots; all the other battleships and battle cruisers were still in formation.

At about 7.40 Scouting Division I turned away to the northwest for a few minutes and evaded the British battle cruisers, which up to this time had been firing at long range. The *Derfflinger*, which had been hit by about 25 large shells, had only two 12-inch

and two 6-inch guns in commission; she was on fire forward and aft; the fire forward was extinguished; the after magazines had to be flooded.

Now that the first German destroyer flotillas had retired, two more advanced to the attack. Flotilla V approached to within about 7000 yards of the battle fleet, but did not see the battleships, due to the very bad visibility to the eastward; on the other hand, the British battleships covered the destroyers with a heavy fire, as did the Fourth Light Cruiser Squadron; after the German destroyers had fired about six torpedoes at the light cruisers, they turned back without the loss of any boats.

At about 7.40 the destroyers of Flotilla III were intercepted by the Second Light Cruiser Squadron and a division of the 12th Flotilla at the head of the British line and retired without any losses to either side after a long skirmish.

During the lull in the fighting Scheer made his decision for the night:

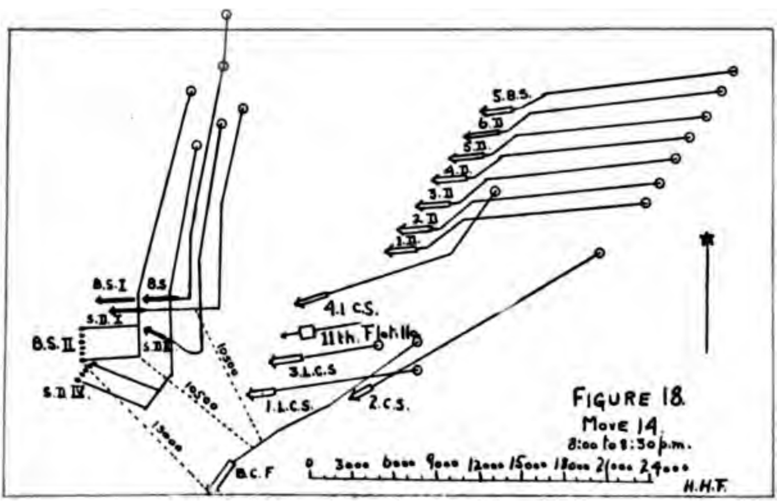
> It might safely be expected that in the twilight the enemy would endeavor by attacking us with strong forces, and during the night with destroyers, to force us over to the west in order to open battle with us when it was light. He was strong enough to do it. If we could succeed in warding off the enemy's encircling movement, and could be the first to reach Horn's Reef, then the liberty of decision for the next morning was assured to us. In order to make this possible all flotillas were ordered to be ready to attack at night, even though there was a danger when day broke of their being unable to take part in the new battle that was expected. The Main Fleet in close formation was to make Horn's Reef by the shortest route, and, defying all enemy attacks, keep on that course.

XVIII. MOVE XIV. THE CLOSE OF THE DAY ACTION (8 to 8.30 p. m. Fig. 18)

At 8.20 the High Sea Fleet was proceeding on a southerly course; Battle Squadrons I and III were proceeding in a single column; the leading ship was the *Westfalen;* Battle Squadron II was on the *Westfalen's* starboard bow; Scouting Division I was on the port, or engaged bow; Scouting Divisions II and IV were ahead.

Suddenly a heavy fire was opened on Scouting Divisions I and II by unseen ships, which were actually the six British battle cruisers; not being able to see their enemy, Scouting Division I changed course to the right 90° in succession and went between

Battle Squadrons II and I. Battle Squadron I followed the battle cruisers; Battle Squadron II received the enemy's fire for a few minutes, but, as the enemy ships could not be seen, this squadron went ships right 90°. This was the only time Battle Squadron II came under heavy fire and the *Holstein* and *Pommern* were each hit by one heavy projectile. While this action was proceeding, Scouting Division IV received its baptism of fire, engaging some light cruisers; by about 8.28 this brief engagement had been completed; the day action had come to a close.



XIX. MOVE XV. THE NIGHT ACTION

(8.30 p. m. 31 May to 3 a. m. 1 June. Figs. 19 and 20)

Soon after the last engagement had been ended, probably about 8.40, the High Sea Fleet took a southeasterly course. At 9.00 p. m. Admiral Scheer states that the leading ship of the battle line was in position 36° 37′ North, 5° 30′ East, and that at 9.06 course was set SSE. ¼ E., speed 16 knots. All the evidence points to the fact that the course was true and not magnetic, for although this was not the direct course to Horn Reefs Lightship, it was the course to the swept channel off Horn Reefs which Scheer shows in a sketch; this sketch indicates that the area immediately off Horn Reefs was filled with both British and German mines. The position of the *Sparrowhawk* and *Rostock* at 3.00 a. m. was within a

few miles of this course, as was the position of the *Dublin,* when at 4.25 a. m. she reported sighting a cruiser—probably the *Regensburg*—and two German destroyers. A course of 156° may therefore be accepted as correct for the night run of the High Sea Fleet.

Admiral Scheer's 9.00 p. m. position and Admiral Jellicoe's 9.00 p. m. position are only about 3 miles distant from each other;

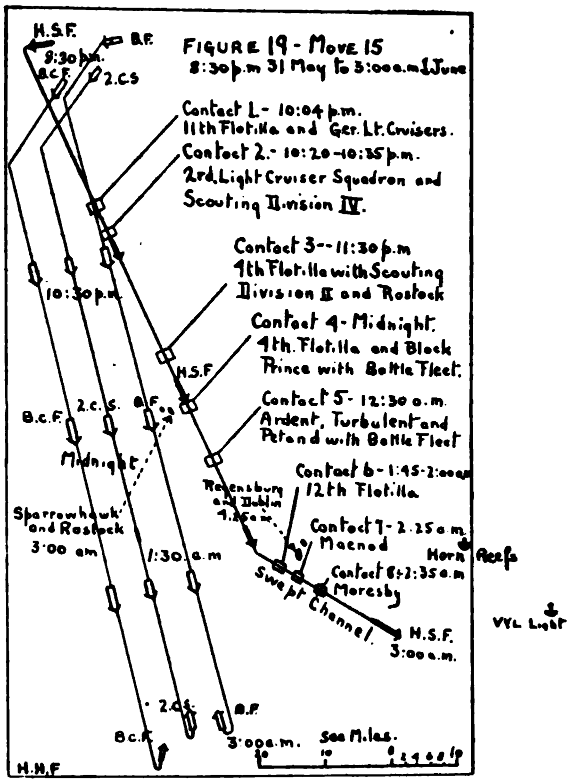


FIGURE 19 - MOVE 15
8:30 p.m 31 May to 3:00 a.m. 1 June

Scheer's position is therefore moved about 2 miles to the northward.

The formation of the German battle line during the night was as follows:

Battle Squadron I, led by the *Westfalen,* Captain Redlich.
Fleet Flagship.
Battle Squadron III, led by the *Kaiserin,* Captain Sievers.
Battle Squadron II, probably led by the *Hessen.*

The two leading squadrons were in inverted order; it is believed that the last squadron was also in inverted order, but there is some doubt in this case.

Ahead of the line was Scouting Division II, on the starboard beam Scouting Division IV and astern Scouting Division I. Of this division only the *Derfflinger* and *Von der Tann* were in line; the *Lutzow, Seydlitz* and *Moltke* followed astern but were not

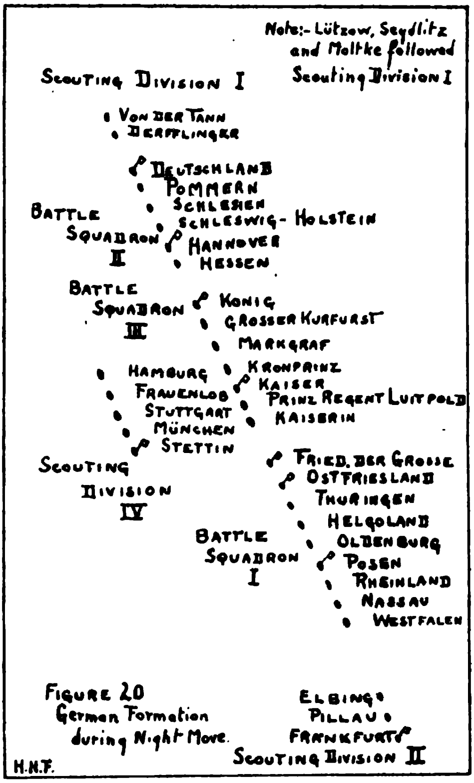


Figure 20
German Formation during Night Move

in the formation; the *Lutzow* could still make 15 knots and the *Seydlitz* 21. At 9.00 Admiral Hipper hoisted his flag on the *Moltke,* which apparently still could make full speed.

Flotillas II, V, VII and some boats of VI and IX were spread through a sector from eastnortheast to southsouthwest and proceeded to the attack, meeting, however, only light British craft. The 1st Half Flotilla were standing by the *Lutzow;* other boats were kept with the *Rostock* and *Regensburg* in reserve; many boats had expended all their torpedoes in the day action.

At 10.04 the first important contact of the night occurred; the light cruiser *Castor* and the 11th Flotilla ran into German light cruisers, probably Scouting Division II. The *Castor* was hit and slightly damaged; she fired a torpedo, as did the *Magic* and *Marne*, but no hits were made.

At 10.20 Contact 2 was made; the Second Light Cruiser Squadron, which was proceeding to the southward astern of the easterly battle squadron of the Grand Fleet, engaged Scouting Division IV. In a sharp engagement at point blank range which lasted for 15 minutes, the *Southampton* and *Dublin* were badly damaged; on the German side the *Frauenlob* was sunk by a torpedo from the *Southampton*, and the other light cruisers received a total of about 12 hits. This engagement was in plain sight of both battle fleets, which at this time could not have been more than from 2 to 3 miles apart.

At 11.30 the 4th Flotilla attacked the *Rostock* and *Elbing*, which were at that time on the port beam of Battle Squadron I. The *Rostock* was hit by a torpedo, probably fired by the *Broke* or *Spitfire;* the boats of Flotilla III rescued the crew, and the ship sank about 3 a. m. During the attack the *Elbing* attempted to pass through Battle Squadron I, but was rammed by the *Posen:* she was blown up at 2 a. m., the crew being saved by a boat of Flotilla III. No other German ships were torpedoed. The British lost the *Tipperary*, sunk by gunfire, and the *Sparrowhawk*, which was rammed by the *Broke* and had to be sunk the next morning: the *Broke* was damaged by gunfire and collision and the *Spitfire* by a collision with a German cruiser.

At about midnight four boats of the 4th Flotilla regained contact and fired torpedoes at German battleships, probably Battle Squadron I; the *Fortune* was sunk; no torpedoes hit. At about the same time a large British cruiser, probably the *Black Prince*, was sighted by the *Thuringen* and *Ostfriesland* and sunk after having been under fire at 1500 yards range for about four minutes.

At 12.30 a. m. the fifth important contact took place; the destroyer *Ardent* made a second attack and fired a torpedo, but was sunk by gunfire; only two of her crew were saved; the torpedo did not hit; at the same time the *Nassau* rammed and sank the destroyer *Turbulent* and damaged the *Petard* by gunfire.

It seems probable that at about 1.30 a. m. the High Sea Fleet reached the entrance to the swept channel and changed course to about 120°.

Meanwhile the *Lutzow* was speedily becoming unmanageable; about 7000 tons of water had been taken on board; for a time she proceeded stern first at four knots; finally the screws were above the water; at 1.45 the crew was taken off by four destroyers, *G-40, G-37, G-38* and *V-45,* and the ship sunk by a torpedo. The destroyers twice made contact with British light forces; on the second occasion *G-40* had her engines injured by gunfire from the light cruiser *Champion,* which reported being attacked by four destroyers at 3.30 a. m. One of the other destroyers took *G-40* in tow; when this report reached the fleet, the *Regensburg* turned back and took over the tow; she apparently was sighted by the *Dublin* at 4.25 a. m. just entering the swept channel.

At about 2.00 a. m. the 12th Flotilla attacked the German battle line, probably Battle Squadron I. Fifteen torpedoes were fired; the destroyers claimed at least one hit; there is no material evidence to support such a claim. At 2.25 the *Maenad* fired torpedoes and claimed a hit; this might have been the *Pommern,* which the Germans state was sunk at 2.20 a. m. It was considered for a long time that two vessels of the *Konig* class were torpedoed at this time; this rumor probably was based on the fact that on 5 November, 1916, the *Grosser Kurfurst* and *Kronprinz* were torpedoed by British submarines, while protecting *U-20,* which had run aground off the Danish coast.

At 2.35 a. m. the destroyer *Moresby* fired a torpedo at what were supposed to be four ships of Battle Squadron II and claimed that an explosion was heard; this may have been the *Pommern,* which was hit by a torpedo, exploded and sank with all hands.

At 2.50 a. m. *V-4* hit a mine and was lost with all its crew; at this time the German destroyers were passing through the field laid by the British mine-laying destroyer *Abdiel.* At 11.00 p. m. *S-32* had been hit in its boiler compartment, but managed to reach Danish waters, whence it was towed in by other German destroyers.

At 3.00 a. m. Admiral Scheer assembled his forces off Horn Reefs; he decided to wait there for the *Lutzow,* information of whose loss had not reached him.

He had with him the following forces:

Dreadnought battleships......	16, of which 3 were considerably damaged by gunfire.
Pre-dreadnought battleships...	5, all practically undamaged.
Battle cruisers................	4, all badly damaged.
Light cruisers................	6, of which nearly all were somewhat damaged.
Destroyers	58 approximately, of which many had fired all their torpedoes.

In addition, four destroyers were carrying the crew of the *Lutzow;* they were being escorted by the *Regensburg;* about four boats were carrying the crews of the *Rostock* and *Elbing;* the ten boats of Flotilla II had returned through the Skagerrak.

After waiting one-half hour, information was received that the *Lutzow* had sunk, and Scheer continued on through the swept channel; at 5.30 off the island Sylt, the *Ostfriesland* was damaged by a mine; only 400 tons of water was taken on board and the ship reached port easily. It is possible, but not probable, that the mining of this ship was effected by the British minelaying destroyer *Abdiel.*

On 1 June at 4.20 p. m. *U-46* fired a torpedo at long range at the disabled *Marlborough;* Admiral Scheer claims that *U-21* torpedoed a British destroyer on 31 May and that the *U-22* hit another destroyer on 1 June. A submarine minelayer placed a minefield off the Orkney Islands, which on 3 June caused the loss of the *Hampshire* with Lord Kitchener.

XX. THE GERMAN LOSSES

VESSELS SUNK. (DISPLACEMENTS GIVEN BY ADMIRAL SCHEER)

Battle cruiser...........	1	*Lutzow*	26,700
Old battleship...........	1	*Pommern*	13,200
Light cruisers...........	4	*Wiesbaden, Elbing, Rostock, Frauenlob*	17,150
Destroyers	5	*V-4, V-27, V-29, S-35, V-48*	3,680
Total	11		60,730

VESSELS SEVERELY DAMAGED. (NUMBER OF HITS APPROXIMATE ONLY)

Battle cruisers	4	*Derfflinger*	25 hits
		Seydlitz	25 hits; 1 torpedo hit
		Moltke	5 hits
		Von der Tann	4 hits
Battleships	4	*Konig*	6 hits
		Grosser Kurfurst	7 hits
		Markgraf	13 hits
		Ostfriesland	1 mine
Destroyers	2	*G-40*	Engines damaged
		S-32	Boilers damaged

VESSELS MODERATELY DAMAGED

Dreadnought battleships	2	*Helgoland*	1 hit
		Kaiser	1 hit
Predreadnought battleship	1	*Holstein*	1 hit
Light cruisers	5	*Frankfurt*	4 small caliber hits
		Pillau	1 large caliber hit
		Stettin	2 small caliber hits
		Munchen	6 small caliber hits
		Hamburg	4 small caliber hits

In addition several ships were hit by small caliber shells fired by British destroyers during the night action and a few destroyers were hit and slightly damaged.

PERSONNEL LOSSES

According to Admiral Scheer: Killed 2400; wounded 400; total 2800.
According to Commander Bellairs: Officers killed 172; wounded 41; total 213.
Men killed 2414; wounded 449; total 2863.
Grand total 3086 killed and wounded.

XXI. OPERATIONS AFTER THE BATTLE

At 1 p. m. 1 June the High Sea Fleet arrived at Wilhelmshaven. The ships were distributed among the navy yards and shipbuilding companies for repairs as follows:

Wilhelmshaven Yard	*Seydlitz* and *Von der Tann*
	Ostfriesland.
	Helgoland, whose one hit was just above the waterline.
Blohm and Voss (Hamburg)	*Markgraf* and *Moltke.*
Vulkan Works (Hamburg)	*Grosser Kurfurst.*
Howaldt Yard (Kiel)	*Konig.*
Imperial Yard (Kiel)	*Derfflinger.*

By the middle of August the fleet was ready to put to sea with the exception of the *Derfflinger* and *Seydlitz,* which each required about six months' repairs. The *Bayern* joined the fleet.

On 16 August the High Sea Fleet put to sea to carry out the enterprise against Sunderland which had been planned for May. The plan was for the cruisers to bombard Sunderland at sunset with Battle Squadrons III and I 20 miles to the rear in support; the fleet was then to retire; about thirteen submarines, which during the advance would be in three lines on the flanks of the fleet, were then to take assigned stations astern of it, with the hope that British pursuing forces would offer favorable targets, Eight Zeppelins scouted for the fleet.

At 5.05 a. m. the *Westfalen* was hit by a torpedo fired by the *E-23;* she returned to port, escorted by five destroyers.

At 5.55 a. m. the light cruiser *Nottingham* was hit by two torpedoes and at 6.26 by a third; at 7.10 the ship sank, the crew being taken off on two destroyers.

At 2.35 p. m. the High Sea Fleet started its return, as numerous British forces were being reported ahead and on both flanks by their Zeppelin scouts.

At 4.52 p. m. the *U-66* hit the light cruiser *Falmouth* with two torpedoes; the vessel proceeded toward a home port under escort of destroyers.

At about 5.40 p. m. Commodore Tyrwhitt with light cruisers and destroyers made contact with the German Battle Fleet, but about 7.30 p. m. abandoned the pursuit, as "the conditions for night attack proved to be unfavorable."

At 8.45 p. m. *U-65* reported that she had torpedoed a battleship or battle cruiser, but there is no evidence to support this claim.

The next day *U-63* hit the damaged *Falmouth* with two torpedoes and sank it.

No German submarines were lost during the operation, although one was rammed and another damaged by depth charges and had a miraculous escape.

Another operation similar to the attempt against Sunderland was planned for September, but this had to be abandoned because the weather was not suited for Zeppelin scouting.

In October the High Sea Fleet made a sortie well out into the North Sea, but the very rough weather prevented the flotillas

from gaining the positions in which they were to strike at the trade between England and Norway; there were no contacts with British forces during the enterprise.

On the night of 26-27 October Flotillas III and IX and the Flanders Half Flotilla made a successful raid into the Channel.

On 5 November the Fourth Half Flotilla, the *Moltke* and Battle Squadron III were sent out to attempt to save the *U-20,* which had run aground off the Danish coast; in this operation the *Grosser Kurfurst* and *Kronprinz* were torpedoed by a British submarine. When Scheer was reprimanded by the Kaiser for thus risking valuable ships to save a submarine, he stated in reply:

> The dangers which threaten our U-boats on these expeditions are so great that they are justified in demanding the utmost support that the fleet can give them in time of need. On no account must the feeling be engendered amongst the crews that they will be left to their fate if they get into difficulties. Fear of loss or damage must not lead us to curb the initiative in naval warfare, which so far has lain mainly in our hands. To us every U-boat is of such importance that it is worth risking the whole available fleet to give it assistance and support.

It is hoped that this brief account will help to clear up to some extent the mystery with which the tactics of the Germans at the Battle of Jutland has been so long surrounded and to show the relation of this battle to the German naval operations of 1916.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE RÔLE OF THE LINE

By Lieut. Commander F. S. Craven, U. S. Navy

1. The activities of the navy are many, but they all should proceed with but a single end in view—to prepare for war. In general, then, these activities should consist in determining what constitutes preparedness and in putting it into practice.

2. The first process is generally described as planning; the second is administration. Planning lays the foundation for administration. In the routine of peace times and in the conduct of routine activities during war planning must always look ahead because it must determine the aims, consider the means, and lay down the processes—that is, prescribe the organization and its routine. But in the crisis of battle, planning and administration for the purpose of tactics and strategy, become so closely related that they practically constitute a single process which depends on the instantaneous development of the action. Thus we have:

(a) Planning as a separate process.
(b) Administration as distinct from planning, and
(c) Command in war, which combines the two.

3. Planning requires a distinct mental attitude and specific mental equipment. The necessary mental equipment includes intelligence, originality, analytic ability, mental energy, and receptivity, and there must be temperamental qualifications, including open mindedness, fairness, modesty, carefulness, thoroughness, and the ability to collaborate with others. In addition to this equipment the individual who engages in planning functions should have special training, for although it is probably true that an untrained man having proper mental equipment could learn rapidly while he attacks his problems, it certainly is true that time would be saved and mistakes would be avoided were he trained. The intrinsic excellence of his work from the beginning certainly

would be improved by preliminary training. This training must fit him as an expert in lines as follows:

In the general activities of the naval profession.

In the detailed functions of the branch to which he is assigned.

In the methods of scientific problem solving.

In the habit of acquiring exact information.

4. It appears almost superfluous to state that men who plan for the navy must be equipped as thoroughly as possible for their work. They must first be selected, then trained for just this work. In the earlier stages of their development it is inevitable that they will be more versed in the special functions of a selected branch than in the naval profession as a whole, because the one is a part, and thorough knowledge of the whole can only be gained through experience with all parts. Obviously the men who plan should be selected early in their careers so that they may have constant practice, because planning, to be successful, must deal largely with general principles. The ability to distinguish general principles is in itself difficult. To apply them properly to administrative purposes is an art.

5. Pure administration is the course of action required to interpret and to execute plans. In the navy an administrator is called an executive. To interpret plans an executive should possess in some degree the attributes also required for planning. A certain amount of planning experience would therefore be advantageous to him if obtainable without interfering with his administrative training. Opportunity is presented to the young officers who serve as heads of departments of small vessels to gain both types of experience at once. They should be assisted and directed by a well considered course of supervision and instruction by squadron or flotilla staffs.

6. To execute plans there are required attributes of rather a different order. The executive must be:

Possessed of initiative.

Quick to act.

Possessed of good judgment.

Forceful.

Possessed of personality in order to handle men.

Self-controlled.

Of high moral character.

Finally, the executive also requires training to fit him to perform his work, which, however, he must derive largely from experience.

7. When we attempt to define the characteristics for the great leaders who must command our fleets, administer our naval bases, direct the activities of the several elementary functions of the Navy Department, co-ordinate the efforts of the whole—then we must recognize several things. *First,* that these men must possess *all* of these characteristics in marked degree. Such men are rare. They can be but the cream of the many who possess the attributes for the one or the other class of work. *They must be selected* and by a process which shall be as certain as possible in its results. Such selection obviously cannot be made at an early period in their careers. *Second,* that no man can possess within himself the capacity for both planning and administration necessary to handle alone the activities of a great subdivision of the navy. He can only direct the performance of such activities by trained men. In a word, he requires a staff of trained men. In time of peace these men must work together to prepare that subdivision for war. Detailed plans must be made for war activities, and must be tested by application and trial so that they may be correctly matured. Thus these two branches of the staff must work toward a common end, each aiding the other, yet working independently. For planning requires time for research, for experiment, for weighing this against that, for the intense study of the effect of small details on general principles; whereas administration requires instant decisions and quick action so that the numerous demands of a routine may not produce an accumulation of matters unattended to, which spells inefficiency and invites defeat.

8. So it is with the great co-ordinator—the Chief of Naval Operations. He requires by far the most numerous and best trained staff because to direct operations he must have the assistance of men who are themselves the counterparts in experience and ability of the heads of the primary subdivisions. Each of these men requires the assistance of younger men, of both types, so that the volume of work may be handled. Thus we must have a central planning section of superlative excellence which shall investigate and define the basic principles governing the activities of the whole. They must prepare plans so general in nature that they will co-ordinate and develop the activities of subdivisions without restricting their proper freedom of action. They must work in close

collaboration with the administrators at the source of power from whom, alone, they can derive the practical assistance necessary to the maturing of their plans. The plans they prepare become, in brief, the statement of military principles affecting all naval activities.

9. A word about the technical side. How frequently it is remarked that a battleship is the apotheosis of mechanical complexity! The inferences might be drawn that genius must be called to its production and genius also to its successful operation. But there is this difference: the greater the genius involved in production, the less *mechanical* genius will be required for operating. Consider the remark of the skilled advertiser: "A child can run it!" Consider as well the stress and excitement of battle, which seriously reduces the ability of the average man to engage in activities requiring mental effort. Only the simplest acquired habits of action, rendered practically mechanical by drill, can be relied on. What better principle, then, could be found for the design of naval ships and their equipment than to obtain *operational simplicity?* Nor what requiring greater skill of the designer? We must come to a realization that there is a limit to human capacity. We must recognize that superlative engineering talent is produced of superlative qualities made expert by intensive training and extensive experience. No seagoing officer can at once be an expert in his profession and an engineer of equal ability. But it is not beyond his powers to become an expert in his profession and at the same time to gain sufficient knowledge of engineering that he can direct and assist the activities of real engineering experts in attacking naval problems. In fact, we must have officers who spend their time alternately at sea and in this work ashore—and we also must have real engineers to devote their entire time to purely technical matters.

10. There is no logical objection to developing ordnance engineers, propulsive engineers—in fact, all types of engineering experts—from our own ranks, if we feel that our available material in Naval Academy graduates will yield the requisite supply and still provide us with line officers of ability. But these engineers must be recognized as such. They must be educated as such, must receive early training and post graduate training as such, must go through all the long process recognized as necessary in civil life, and more. They will have no time for regular sea

service, nor will their need for constant touch with the technical details of their work permit it, except for those sent forth from time to time to note performances with a technical eye. There would be an advantage in recruiting these men from the Naval Academy because they would have the spirit of loyalty which permeates the service, and they would receive their early training in contact with the sea. But it does not appear to me that the service can afford this method to secure all of its engineering talent. The fascination of technical work appeals to youth, and we would be very apt to lose many of our budding leaders to the ranks of the technicists. This we must not do. The success of the navy in war is the primary consideration, and to ensure it we require a wide field from which to select military leaders. Civil life abounds with engineers from among whom may be drawn the preponderance of talent required. Naval Academy graduates of pronounced technical ability and inclination should be specially trained as engineers after a brief service at sea. They would form a strong link between the line and purely civilian technicists, and would provide a logical field for producing necessary leaders in naval engineering. But we must recognize the fact that civilian technicists of adequate ability must be paid according to the scale prevailing in civil life—we cannot retain such men at the salaries now paid.

11. We may venture now to state the rôle of the line of the navy. It is to study and apply the art of naval warfare; to guide and co-ordinate the production of equipment, to institute appropriate training, to conduct the operations of the navy in the event of war. Three types of men are required: First, the leaders who combine the attributes of the others; second, the planners; third, the executives. And of each type we must know accurately the relative excellence of its membership so that the greatest ability may be applied at the top and the dead wood may be eliminated from the bottom. The fields of activity for these men are both ashore and afloat, but their primary field is the sea, for there alone can they gain first hand the experience which must fit them as experts in their profession, comparable in efficiency with the experts in technical endeavors.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NEW METHODS OF EXTERIOR BALLISTIC COMPUTATION[1]

By Lieut. Commander A. G. Kirk, U. S. Navy

During the war just ended it soon became evident that modern high-powered guns would be fired at elevations considerably in excess of those formerly used. "Direct fire" was more or less out of date in land warfare. These new angles of elevation coupled with high initial velocities gave long trajectories. And in the endeavor to fire from protected positions far in the rear of the line of combat, or to injure the enemy in vital spots well behind its own front line, it was found absolutely necessary to be able to compute with accuracy these long trajectories. Similarly, it was essential that suitable means be provided for correcting the trajectory for any variation from standard conditions.

In general, it may be said that up to the outbreak of the war the calculation of the path of a projectile was performed by the method developed by Siacci. In America his method was modified in certain particulars by Prof. P. R. Alger, U. S. N., and by Major J. M. Ingalls, U. S. A. Essentially, it consisted of simple analytical equations, requiring a single operation for the solution of the entire trajectory. To accomplish this result it was necessary to replace certain of the variables with constants which represented their best mean values. The two factors of the ballistic coefficient which most affect the accuracy of that expression are: First, the constant of integration, β, and second, the altitude factor, f_a. In

[1] This article was originally prepared for the midshipmen at the Naval Academy; permission to print it has been kindly granted by Commander A. P. Fairfield, U. S. N., head of department. For certain information herein I am indebted to a note on "Numerical Integration" by Captain Dunham Jackson, U. S. A., and to the prefatory remarks of Bennett's "Ballistic Tables," by Captain A. A. Bennett, U. S. A.

some quarters it was customary to include still another factor for the range-wind, *fw,* using data obtained from surface conditions only.

The constant of integration, β, has been given the value of unity by Prof. Alger in his work, so long as the angle of departure remained less than 15°. He states that in direct fire such an assumption may be considered correct with less than 1 per cent of error. Above that elevation, an approximation of $\beta=\sqrt{\sec\phi}$ has been proposed; and in certain army tables this value is used throughout (Artillery Circular M, 1917). Since β is the mean value of $\frac{\cos^{n-2}\alpha}{\cos^{n-1}\phi}$, where n is Mayevski's exponent, in long trajectories where α has a value in excess of 15°, considerable error arises from this source. The actual value of β changes throughout the trajectory, being greatest at the terminals and least at the vertex. So that with large angles of departure a mean value is not satisfactory for accurate computation of the trajectory.

The altitude factor, f_a, was intended to allow for the variation in the density of the air with altitude. As the projectile travels in its path, it passes through an air-medium of varying densities. These variations were taken care of in the Siacci method by assigning to f_a a value corresponding to the mean height of the trajectory. Alger has assumed the trajectory on low angles of departure to be a parabola of vertical axis with the mean height equal to two-thirds the maximum ordinate. As the path of the projectile is not parabolic, and differs materially from this form on large angles of departure, a considerable error is introduced from this source.

It might also be mentioned that certain range-table assumptions with reference to standard conditions under which the data are computed, are not adaptable to any except the given set of range-table conditions. Thus there are several refinements from this cause; which include rotation of the earth, air temperature effect on velocity functions, variations in ballistic wind and density in the upper air, and variations in the amount and direction of the force of gravitation. All of these produce appreciable errors in long trajectories, and for which an adequate method of correction does not exist in the old Siacci method.

The mean-value methods may then be summed up as inadequate for these reasons:

(a) Large angles of departure used and accuracy required, invalidates the assumption that β has any constant value; or can be represented by any simple function of the angle of departure.

(b) The altitude factor, f_a, cannot properly represent the density of the air in simple terms.

(c) The variations from standard range-table conditions are not compensated for with the requisite accuracy.

To meet these objections the method of computing the trajectory by "short-arcs" has been devised. At the same time the basic tables have been revised and corrected, and additional data included in their construction or in their application. The method used in America was developed by Major F. R. Moulton, U. S. A., and modified from time to time by the Technical Section, Artillery Ammunition Division, Army Ordnance Department.

In its broadest aspect, this new method consists simply in first resolving the velocity of the projectile along its trajectory into its two components: one parallel to the horizontal plane through the muzzle of the gun, and the other parallel to the vertical plane through the muzzle. Then finding expressions for the change in each component during small intervals of time, and thus determining the position of the projectile in space at the termination of the given time-interval. By proceeding in this way, the data governing the position of the projectile are determined at short intervals of its path and the whole trajectory is thus developed by a series of "short-arcs." Or, in more precise language, the process consists in setting up the differential equations of motion of the projectile, and then integrating them mechanically, or step by step, with the time (t) taken as the independent variable. "The treatment of the differential equations is based directly on the fundamental fact that a derivative is a rate of change, and that the value of a quantity can be computed step by step when its rate of change is known."

One primary assumption has been made: That the axis of the shell stays in the trajectory so that the resistance it encounters at any point may be considered to act along the tangent to the trajectory at that point. While not true in the horizontal plane (witness "drift"), yet so far this assumption seems to be fairly correct, in the present state of our knowledge, for the vertical plane.

The next step is to show how the resolved components of the initial velocity are affected by the retarding forces they encounter. Then it will be possible to get an expression for the acceleration each component undergoes during any increment of time.

First of all, it will be evident that the projectile in flight may be considered to have acting upon it, in still air, two forces: The attraction of the earth, and the resistance of the air.

The attraction of the earth, or the force of gravitation, varies with the altitude and this refinement may be introduced. Likewise in a long trajectory, the direction of this force is not always normal to the trajectory: thus two components must be used to replace a single quantity. Tables for the above variations in "g" have been prepared and are used as indicated.

The resistance of the air, or the retardation it produces, is taken to be directly proportional to some function of the velocity of the projectile and to the density of the air; and inversely proportional to the uncorrected ballistic coefficient. In ballistic tables formerly in use, the value of the velocity function was tabulated from Mayevski's expression $R = -\frac{A}{C} v^n$ where both A and n changed with different velocities. The graph of this function, while continuous, plots with square corners (in other words, sudden changes), at the points of juncture of different values of the exponent. Later experiments and a general survey of the data at hand, have resulted in the construction of a new curve, essentially similar to the old one but much smoother at the points of change. For the present this must be accepted as the best available, though it is hoped that experimental work now in progress may modify and simplify our data on this important subject. For the computation of trajectories, however, the curve proper is not used: instead, the data is picked off and arranged in tabular form for ease in handling. This table is known as the "G-table." For certain reasons connected with the computations, the entering argument is $\frac{v^2}{100}$ with which is picked out the $G(v)$ function (this being the logarithm of the retardation divided by the velocity). That is to say, the table gives the logarithms of the result of dividing the retardation caused by air of unit density on a shell of unit ballistic coefficient, by the velocity at which the shell is travelling. This expression is called the G-function, and is sometimes written

" $G(v)$ " since it is a function of the velocity. The table is in metric units.

That the resistance offered by the air will be proportioned to its density is a logical conclusion. In calculating the formula from which to compute the necessary tables, considerable data were at hand which the progress in meteorology has made available. This table is called the H-table, or the H-function, sometimes being written $H(y)$ as the density is, obviously, a function of the altitude. At the present time the table is in the metric system and gives the logarithm of the density with values of y as argument.

The presence of the uncorrected ballistic coefficient, or, as it is called in the new method, " the ballistic coefficient," in the denominator of the retardation formula is accounted for by the reasoning employed by the earlier ballisticians. The G and H tables above-described are prepared for a shell of ballistic coefficient equal to unity, and any change in value from unity simply changes the amount of retardation experienced by the shell. In other words, we should expect a shell of large ballistic coefficient to do better work in penetrating the air than one of smaller value. In the form used in this new method the expression is $C=\frac{w}{id^2}$ where the symbols have their customary significance.

Before going ahead with the equations, it may help to a clearer understanding if certain conventional symbols be explained. When the vector-quantity V, is resolved on rectangular coordinates, the components are written X' and Y'. That is to say, if we denote the X-axis component by V_x and the Y-axis component by V_y, we could write

$$\frac{dx}{dt}=V_x=X'$$

$$\frac{dy}{dt}=V_y=Y'$$

Then the second differentials, or the *rates of change* of these quantities, which means the accelerations, are

$$\frac{d^2x}{dt^2}=X''$$

and

$$\frac{d^2y}{dt^2}=Y''$$

Thus:
V = velocity along the trajectory.
X = distance along X-axis.
Y = distance along Y-axis.
X' = component of V parallel to X-axis.
Y' = component of V parallel to Y-axis.
X'' = acceleration parallel to X-axis.
Y'' = acceleration parallel to Y-axis.

With these conventional symbols in mind, we can proceed with the development of the fundamental equations of motion.

It will be remembered that in the older method the symbol R denoted the retardation. We now introduce a new symbol, F, which is the retardation divided by the velocity: then

$$F=\frac{R}{V} \text{ or } R=FV.$$

Then we are able to write, from the general statement of the retardation caused by the air and the definition of the functions involved.

$$F=\frac{I}{C} \,.\, G(v) \,.\, H(y).$$

With the usual system of coordinates, the X-axis horizontal and positive down the range, the Y-axis vertical and positive upwards, let us call X' the horizontal component of the muzzle velocity, and Y' its vertical component. Evidently

$$V^2=\overline{X'}^2+\overline{Y'}^2$$

and of course

$$X'=V \cos \phi$$
$$Y'=V \sin \phi \text{ where } \phi=\text{angle of departure.}$$

The accelerations of the components, X' and Y', of the velocity, we denote by X'' and Y''. The retardation acting along the tangent to the trajectory can also be resolved into two components, horizontal and vertical, which we call R_x and R_y.

Then
$$X''=R_x=-FX'$$
$$Y''=R_y=-FY'-g,$$

since, by a well-known principle of mechanics, the force acting in any direction is equal to the acceleration it produces (in other words, when $m=1$, $f=a$).

These last two equations are the fundamental equations for the solution of the trajectory in still air. They are solved by what is called numerical, or mechanical, integration, which is an approxi-

mate method capable of almost any desired degree of accuracy. It is not intended to enter into any discussion of the principles involved, save to state it is a well-known mathematical process used in the preparation of astronomical tables, for example. The important point is that values of the accelerations, X'' and Y'', are computed for small increments of time, and from these known values of the rate of change, the velocity-components, X' and Y' are found; and hence the values of the distances travelled in the two dimensions, X and Y, are determined. By keeping the time-interval small at the beginning, the differences of the tabulated values of $X, X', X''; Y, Y', Y''$ are kept fairly smooth. Then the time interval may be increased and the work of computation speeded up without loss of accuracy.

It will be seen that we know, in the beginning, that $X=O$ and $Y=O$, when the shell leaves the muzzle. Likewise, $t=O$. As t increases, say first to $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ seconds, then to 1, 2, 3, —— seconds, and so on, the values of X gradually increase. The values of Y increase until the maximum value is reached at the vertex, Y_0; from this point onwards the values of Y grow smaller until finally the projectile lands. X' is constantly decreased by the horizontal component of the retardation aided, in long trajectories, by the horizontal component of g. Y' is decreased by its component of the retardation plus the downward component of gravity until the two forces balance, when $Y'=O$ and the shell passes over the top of the trajectory. From here on the pull of gravity aids the downward velocity-component and increases the value of Y' until the shell lands. The terminal values of X' and Y' give the angle of fall and the striking velocity.

Thus, by this method, we have tabulated before us all data concerning the projectile at a great number of points in its path. We have computed its trajectory in still air without recourse to any factors save the vector-quantities involved. The method is slow and somewhat laborious, but the accuracy of the result justifies this expense under the given condition of high elevations and velocities.

One other most important feature of Major Moulton's method lies in the accuracy with which the effects of variations from standard conditions can be determined. This has been done by the ingenious system of differential equations, devised by Prof. Bliss at Aberdeen. The subject is too large to be more than mentioned, except to draw attention to the fact that each variation

is evaluated for its effect during each time-interval, and for the the particular position of the shell. The following list gives the variations from standard conditions which are normally corrected for:

1. Difference in angle of departure and muzzle velocity.

2. Rotation of the earth (only in extreme cases).

3. Variations in range and deflection, caused by the ballistic wind.

4. Variations in range due to density, or change in the ballistic coefficient.

5. Variation in the $G(v)$ function with air-temperature changes.

These variations are applied by means of weighting-factor curves, which are so constructed as to give the proportion between the effect of a unit disturbance acting throughout the entire trajectory, and the same effect acting throughout any given part of the trajectory. Their construction is not very difficult and their use quite simple.

The data from which the effects of the two components of the wind are computed, are collected by observing and plotting the path of a small balloon, released from a known point on the earth. This balloon has certain pre-determined characteristics which make the record reasonably accurate. The plotting enables one to determine the force and direction of the wind in the upper air, and to allow for the changes which take place with altitude. The density at present is determined by observations taken by an airplane and is used in the same way as the ballistic wind.

Thus it will be seen that this new method of computation is more exact; free from mean values of constants; capable of applying more accurate corrections for variations from standard conditions; and able to compensate for more variables. It should be said that this paper merely aims to sketch the briefest outlines of the new method with its recent developments, and to indicate the lines in which the science is now progressing. It is to be understood that rapid advances may be made in our knowledge of the velocity-function, in our density tables, and in many other directions, without introducing any error in the fundamental principles involved; as exterior ballistics must still be considered an experimental science. With improved types of shell, higher muzzle velocities, and greater angles of departure it is important that naval officers be cognizant of the elementary principles involved in the computation of the resultant trajectories.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

USING AN OLD WRINKLE

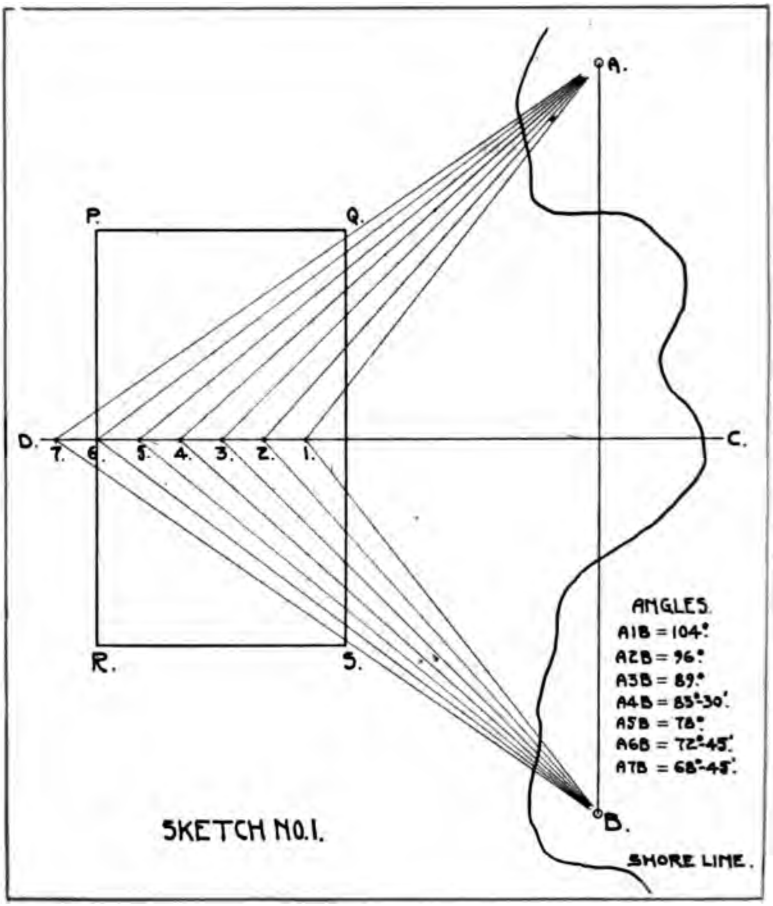
By Commander C. N. Hinkamp, U. S. Navy

While engaged in mine sweeping on the French coast, in waters where the currents are strong it became necessary to use more than ordinary care in keeping the track of the areas covered, and the following method of navigating these waters when sweeping was frequently used. Never having seen it described in the Proceedings of the Naval Institute, I submit it for the information of the service after extensive use in the World War, on the mine fields off the entrances to St. Nazaire.

The idea is the application of the old principle of passing a danger by the use of the danger angle, which is based on the fact that a chord of a circle subtends the same angle from any point in the circumference of that circle. Sketch No. 1 shows all the work necessary for the execution of the idea, while Sketch No. 2 shows the geometric proof and the actual paths traversed by the vessels.

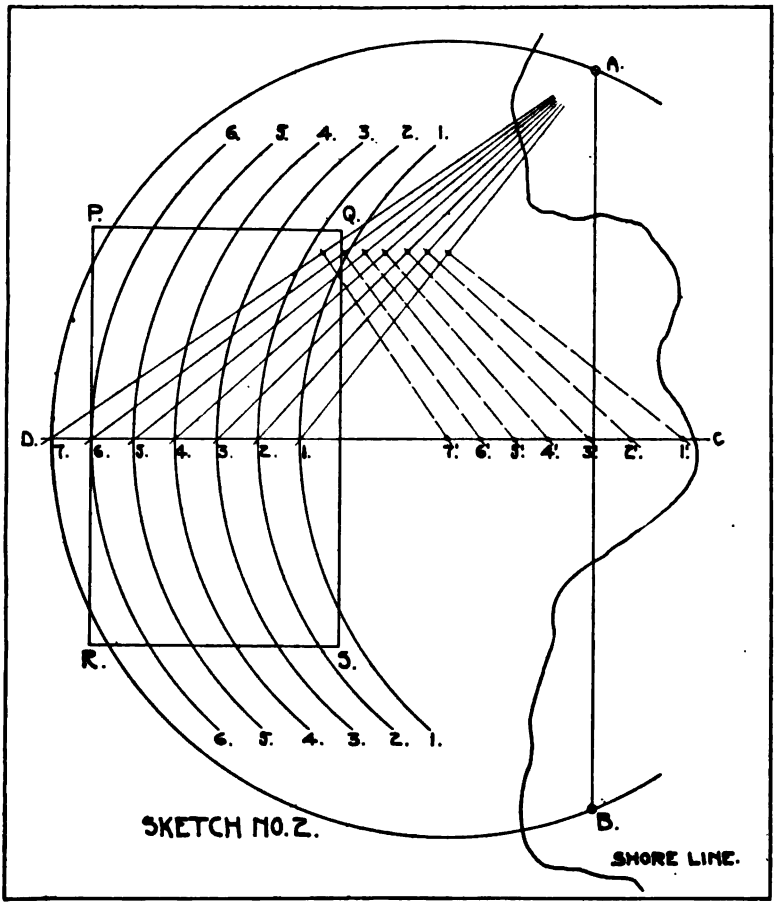
Taking Sketch No. 1, suppose the dangerous mined area to be included in the space *PQRS*. Select two prominent landmarks on shore, lighthouses, churches, or other forms of towers, preferably so located or selected as to be about equidistant from the center of the area. They need not be exactly equidistant from the center of the area, but this is desirable for simplicity, and easy execution. Suppose the points to be *A* and *B*. Join *A* and *B* and in the center of *AB* erect a perdendicular *CD* which will pass through the area *PQRS* if the points are well selected. On the line *CD*, and within the limits of the area, lay off to scale the width of the path which can be swept by the complement of sweepers, and call these points in succession, *1, 2, 3, 4, 5, 6, 7*, etc. Next join *A-1, A-2, A-3, A-4, A-5, A-6, A-7*, and *B-1, B-2, B-3*,

B-4, etc. Measure with a protractor the angles *A1B, A2B, A3B*, etc., marking them on the chart. Set the angle *A1B* on the sextant and maintain this angle between these landmarks, by maneuvering the ship to the right or left until the limiting bearings of the area are reached. After a bit of practice it is simple to tell which way



to put the rudder to keep the angle, as the right object moves to the right or the left of the left object. A surveying or horizontal sextant is best adapted for this purpose, although we used an ordinary sextant fitted with a handle specially made on board ship. After passing the limits of the area and desiring to make the return trip on another angle, make the turn, set the sextant to the

next angle, *A2B,* and get on that angle by maneuvering the ship. When the lower limits of the area are reached, make the turn, set the sextant to the angle *A3B,* and get on that angle. Keep this up until the entire number of angles have been cruised over, and the area has been swept if the leading vessel kept the angles, and



the following vessels kept their position accurately on the leader. By this method no regard need be paid to the current as the only thing to remember is to *keep on that angle* no matter how oddly the ship may be heading.

For those who are skeptical, and I have seen many, I will submit a little proof construction to remove any doubts that may

remain. Take Sketch No. 2, and carry out the work started in Sketch No. 1, first, mark carefully points *1, 2, 3, 4, 5, 6, 7*, etc., for identification purposes, and bisect *A-1, A-2, A-3, A-4*, and erect perpendiculars at these points intersecting the line *CD* in the points *1', 2', 3', 4', 5'*, etc. With point *1'*, as a center, and with radius equal to *1'1*, draw the arc of a circle, and it will pass through *A* and *B*. The arc *1-1-1* is the path traveled over if the angle *A1B* is held. For the second curve, take the point *2'* as a center, and with radius *2'2* describe a circle and it will pass through the points *A* and *B*. The same may be done for all the points and the same results will be found to occur. This method is useful near shore, but there is no reason why it can't be used off shore using two ships or buoys of known position.

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THE BRITISH BLOCKADE AND AMERICAN PRECEDENT

By JULIUS W. PRATT

In one vital respect the British and Allied blockade in the World War differed from all previous blockades. Whereas other blockades had shut off commerce through the ports of the blockaded belligerent, this blockade shut off also belligerent commerce through the ports of neighboring neutral countries. Of this vital difference there is no question. The question which I wish to examine in this article is as follows: Did the new type of blockade rest upon a new principle, or was it a natural development from established precedent, the application of the principle being merely modified to conform to new conditions? I think it can be shown that the latter was the case, that the British blockade policy was an almost inevitable outgrowth of earlier practice, and that Americans above all people are not in a position to find fault with it.

It was to the United States that Great Britain looked for the precedents for much of her policy. The blockade of the Southern coasts in the Civil War represented, prior to 1914, the summit of complete and successful blockade. In it the United States Government had pushed the theory of blockade almost, though not quite, to its logical conclusion. The aim of the blockade of the Southern coast was an absolute stoppage of trade. Therein it differed from the British blockade of France in the Napoleonic wars. In the latter the blockade policy had been complicated by the need of sustaining British commerce, and the government had licensed and encouraged certain forms of trade with the blockaded continent. In the Civil War no such complicating motive entered. The policy of the United States Government, therefore, presented

to Great Britain the best possible example of a blockade of the sort desired.

A consideration of certain cases arising during the Civil War will show how nearly the United States had anticipated the recent British policy. The principal difficulty in enforcing the blockade arose from the proximity to the Southern coast of certain neutral territory, notably the British port of Nassau in the Bahamas, and Mexico. The former offered excellent opportunities as a base from which blockade-runners, awaiting their chance, might slip into the Confederate ports of Savannah, Charleston, or Wilmington; while from the latter, goods landed in neutral Mexican ports might be shipped overland into the Confederate State of Texas. Nassau in particular became a thriving seat of the new industry. Here the low, swift steamers engaged in eluding the blockading fleet either stopped in their passage to coal and await the most favorable time, or else picked up cargoes deposited for them by other ships from foreign ports.

To facilitate the enforcement of the blockade the Federal Government invoked the so-called "doctrine of continuous voyage," first developed by Great Britain during the Napoleonic Wars in enforcing the Rule of 1756. Under the latter rule, trade in neutral bottoms between France and her colonies, unlawful under French law in time of peace, was held equally unlawful in time of war; and the "doctrine of continuous voyage" declared that such trade was not legalized by the circumstance of the vessel's touching or even unloading her cargo at neutral ports such as those of the United States. The voyage from a French colony to France was *continuous,* even though the two portions of it might be made in distinct ships. The criteria determining the lawfulness of the conveyance were the true origin and the ultimate destination of the cargo.

The principle thus set up gave the United States Government a useful weapon. Acting upon it, United States cruisers seized, and United States courts condemned, ships and cargoes of neutral ownership on their way from British ports to Nassau, provided only it could be shown that the ultimate destination of the cargo was a blockaded port. If a breach of blockade was the ultimate purpose of the voyage, then the entire voyage partook of that character, and ship and cargo were subject to seizure even though their ostensible destination was Nassau, a port in neutral terri-

tory. The Supreme Court, it is true, in reviewing the cases, modified somewhat the rigor of the prize court decisions, holding that a ship itself, though carrying cargo of unlawful destination, was not subject to seizure for breach of blockade if the ship-owners were unaware of the unlawful destination of the cargo. Such innocence removed, however, there was no doubt of the liability of both cargo and ship.

This principle was most clearly established in the cases of the *Bermuda* and the *Springbok.* The *Bermuda* (3 Wall. 514ff.), a vessel ostensibly of British ownership, had sailed in 1862 from Liverpool for Bermuda, and on April 26 was captured by a Federal cruiser while proceeding from the latter port to Nassau. Vessel and cargo were condemned by the Prize Court, and in 1865 the case came to the Supreme Court by appeal. The finding of the lower court was affirmed, first on the ground of the strongest presumption of enemy ownership and obvious bad faith in the ship's papers. But these were not the only grounds for condemnation. "What has been already adduced of the evidence," said the court, "satisfies us completely that the original destination of the *Bermuda* was to a blockaded port; or, if otherwise, to an intermediate port, with intent to send forward the cargo by transshipment into a vessel provided for the completion of the voyage. . . . . It is quite clear to us that . . . . the voyage, begun at Liverpool with intent to violate the blockade, delayed at St. George's for instructions from that firm [John Frazer & Co.], continued toward Nassau for the purpose of completion from that port to a rebel port, either by the *Bermuda* herself or by transshipment, was one voyage from Liverpool to a blockaded port, and that the liability to condemnation for attempted breach of blockade was, by sailing with such purpose, fastened on the ship as firmly as it would have been by proof of intent that the cargo should be transported by the *Bermuda* herself to a blockaded port, or as near as possible, without encountering the blockading squadron, and then sent in by a steamer, like the *Herald,* of lighter draft or greater speed." Therefore, "both vessel and cargo, *even if both were neutral,* were rightly condemned."

The circumstances in the case of the *Springbok* (5 Wall. 1ff.) were somewhat different. This vessel sailed from London in December, 1862, and, like the *Bermuda,* was captured on her way to Nassau by a United States cruiser. She was of *bona fide*

British ownership; her papers were regular and genuine and showed a neutral destination, Nassau; her owners "did not appear to have any interest in the cargo, nor was there any proof that they knew of its alleged unlawful destination." On these grounds the ship, condemned by the lower court, was ordered restored to its owners. As to the cargo, the Supreme Court held that, "contraband or not, it could not be condemned, if really destined for Nassau and not beyond, and, contraband or not, it must be condemned if destined to any rebel port, for all rebel ports were under blockade." The court then proceeded to deduce from the character of the cargo, a part of which was contraband peculiarly fitted for the use of the Confederate armies, that the destination was indubitably a blockaded port, and that the owners of the cargo purposed to transship in into some vessel better fitted than the *Springbok* for blockade-running.

"Upon the whole case," the opinion concluded, "we cannot doubt that the cargo was originally shipped with intent to violate the blockade; that the owners of the cargo intended that it should be transshiped at Nassau into some vessel more likely to succeed in reaching safely a blockaded port than the *Springbok;* that the voyage from London to the blockaded port was, as to cargo, both in law and in the intent of parties, one voyage; and that the liability to condemnation, if captured during any part of that voyage, attached to the cargo from the time of sailing."

Thus was established the principle that a belligerent might seize neutral cargoes in neutral ships sailing between neutral ports, provided it could be shown with reasonable certainty that the ultimate destination of the cargoes was in reality a blockaded port of the enemy. If the owners of the ship were privy to the purpose of the cargo, then the ship too was liable to condemnation for breach of blockade.

One further step, however, the United States declined to take. If the subsequent carriage of the goods from neutral to enemy territory was not through a blockaded port but overland, then there could be no interference with neutral ship or cargo, contraband only excepted. This position was declared in the case of the *Peterhoff* (5 Wall. 28ff.). The latter was a British merchant steamer, captured in 1863 *en route* from London to Matamoras. Mexico. The town of Matamoras lay on the southern bank of the Rio Grande, opposite Brownsville, Texas. It became, during

the war, the seat of a considerable trade with Texas, receiving not only from Europe but from United States ports cargoes of whose enemy destination there could be little doubt. The holding of the court in the *Peterhoff* case came under two heads: (1) A small portion of the vessel's cargo was absolute contraband; this was condemned as destined unquestionably for the Confederate forces in Brownsville. (2) On the other hand, it was held "that neutral commerce with Matamoras, except in contraband, was entirely free"; that "neutral trade to or from a blockaded country by inland navigation or transportation" is lawful; and, "therefore, that trade between London and Matamoras, even with intent to supply, from Matamoras, goods to Texas, violated no blockade, and cannot be declared unlawful." "Such trade," said the court, "with unrestricted inland commerce between such a port and the enemy's territory, impairs undoubtedly and very seriously impairs the value of a blockade of the enemy's coast. But in cases such as that now in judgment, we administer the public law of nations, and are not at liberty to enquire what is for the particular advantage or disadvantage of our own or another country."

In delivering this opinion Chief Justice Chase took high and admirable ground. The law of nations was to be administered without regard to national needs or national danger. In weighing his opinion, however, two facts should be borne in mind. First, the case did not come before the Supreme Court until 1866, when the war had been ended some twenty months. Second, the situation at Matamoras and Brownsville had never presented any serious danger to the nation. Brownsville was far removed from the actual scene of war and was not even connected by railroad with more vital parts of the Confederacy. In fact, before the date on which the *Peterhoff* was sent to the Prize Court, Federal control of the Mississippi had practically confined the war to the southeastern theater and made impossible any large scale transportation from west to east. It was inconceivable that the importation of supplies through Mexico and Texas could have any decisive effect on the outcome of the war. Had communications between Virginia and Texas been in any way analogous to those between Prussia and Holland or Denmark, and had the resulting danger been still in existence when the case was decided,

we may well question whether national advantage would have been given so low, the law of nations so high, a place in the decision.

European opinion upon the *Bermuda* and *Springbok* cases is of much interest. Continental nations heard the decisions with the strongest disapprobation, which was frankly voiced by Dutch, German, and French writers. "It matters not," said Count van Lynden van Sandenburg, Minister of State of the Netherlands, in speaking of the *Springbok* case, "who the owners of the cargo may be, to what nationality they may belong, whether they are English, French, Dutch, or even American. A great principle is at stake, and the only satisfactory and conclusive proof that the United States Government can give, that it at length abandons and denounces a doctrine destructive of neutral trade, and a judgment pronounced in error, will be the awarding full compensation to the despoiled owners of the cargo, the long-suffering victims of a flagrant miscarriage of justice."[1]

The German view was expressed by Professor Gessner, Imperial Councilor of Legation at Berlin: "The doctrine, however, upon which the Supreme Court of the United States has condemned the entire cargo of the *Springbok,* a neutral vessel, on her way to a neutral port, is quite monstrous, more especially as the court acquits that *vessel* of any intention to violate the blockade. If such a doctrine were carried to its logical conclusions, and were enforced by a belligerent great maritime power as rigorously as it has been by the United States, all neutral property on the high seas might be treated as lawful prize of war."[2]

"The decision," wrote M. Fauchille, "rests on the fiction that though the vessel in which the goods are to be carried is changed at the intermediate port, yet the voyage is the same; and the reason would apply no matter how many changes the goods might be subjected to, or how many successive neutral ports they might pass through. But international law repudiates such fictions, international law being eminently a law based on common sense. The fiction in the present case imposes on neutral commerce restrictions irrationally onerous. . . . The theory of continuity of voyage destroys the freedom of the seas, and the commercial freedom of neutrals."[3]

[1] H. of R. Document No. 551. Vol. VII, p. 730.
[2] *Ibid.*, p. 733.
[3] *Ibid.*, pp. 734-5.

A more authoritative condemnation of the principle underlying the *Springbok* decision was the unanimous pronouncement of the Maritime Prize Commission, nominated by the Institute of International Law to frame a scheme of international maritime prize law, and embracing jurists from Belgium, Holland, Germany, England, Russia, Italy, and France. The commission declared, in part:

That the theory of continuous voyages, as we find it enunciated and applied in the judgment of the Supreme Court of the United States of America, which condemned as good prize of war the entire cargo of the British bark *Springbok* (1867), a neutral vessel on its way to a neutral port, is subversive of an established rule of the law of maritime warfare, according to which neutral property on board a vessel under a neutral flag, whilst on its way to another neutral port, is not liable to confiscation by a belligerent as lawful prize of war; that such trade when carried on between neutral ports has, according to the law of nations, ever been held to be absolutely free, and that the novel theory, as above propounded, whereby it is presumed that the cargo, after having been unladen in a neutral port, will have an ulterior destination to some enemy port, would aggravate the hindrances to which the trade of neutrals is already exposed, and would, to use the words of Bluntschli; "annihilate" such trade, by subjecting their property to confiscation, not upon *proof* of an actual voyage of the vessel and cargo to an enemy port, but upon *suspicion* that the cargo, after having been unladen at the neutral port to which the vessel is bound, may be transshipped into some other vessel and carried to some effectively blockaded enemy port. . . . .

That, furthermore, the result would be that, as regards blockade, every neutral port to which a neutral vessel might be carrying a neutral cargo would become *constructively* a blockaded port if there were the slightest ground for *suspecting* that the cargo, after being unladen in some neutral port was *intended* to be forwarded in some other vessel to some port actually blockaded.[4]

Any one who compares the above comments with the course of events in the World War will be struck by the accuracy with which the writers foretold the misfortunes for neutral shipping lying in the germ in the American decisions. But for England's unforeseen waiving of the right of confiscation for attempted violation of blockade, the paragraphs quoted forecast the Allied policy with much precision.

But while these warnings were being voiced by Continental jurists and an English authority here and there, the British Government was quietly acquiescent. Although British mer-

[4] *Ibid.*, pp. 731–2.

chants and ship-owners were the chief losers by the decisions of the American courts, the British Government not only declined to take diplomatic action for their relief, but repeatedly declared its satisfaction with the American decisions—even with the decisions of the American lower courts in the *Springbok* and *Peterhoff* cases, decisions later held in part unwarranted by the Supreme Court.[8] The explanation appears simple enough. The American decisions not only harmonized in their general spirit with earlier British theory and practice, but were as welcome to a great naval power as they were distasteful to the nations with large commerce and inferior navies. Great Britain, we may suppose, was well satisfied to see the United States establish precedents which she herself might one day find useful.

The question of blockade, as distinct from carriage of contraband, was not raised in the South African War, and not until the London Naval Conference in 1908-09 was an attempt made to settle with finality the rights of a blockading belligerent.

Although, as we have seen, Great Britain acquiesced in the American application of the doctrine of continuous voyage, Sir Edward Grey in his instructions to Lord Desart, British representative at the Naval Conference, took exception to that application. "For the purpose of blockade," he wrote, ". . . . the destination justifying capture is that of the ship, and not of the cargo; and a vessel whose final destination is a neutral port cannot, unless she endeavours, before reaching that destination, to enter a blockaded port, be condemned for breach of blockade, although her cargo may be earmarked to proceed in some other way to the blockaded coast. His Majesty's Government believe that all the other Powers will probably be in agreement on this point, unless the United States were to maintain that the condemnation pronounced by their Supreme Court in the well-known case of the *Springbok* extended the application of the doctrine of continuous voyage to breaches of blockade, and rendered the vessel carrying a cargo destined for a blockaded port liable to seizure, even though she herself was not proceeding to such port. It is, however, exceedingly doubtful whether the decision of the Supreme Court was in reality meant to cover a case of blockade-running in which no question of contraband arose. Certainly, if

[8] *Ibid.*, pp. 723-5.

such was the intention, the decision would *pro tanto* be in conflict with the practice of the British courts. His Majesty's Government see no reason for departing from that practice, and you should endeavour to obtain general recognition of its correctness." [6]

When England was thus ready to abandon the precedents established by American courts—precedents which continental nations had always condemned—it was to be expected that the Naval Conference would discard them altogether. This the conference took pains to do. Three separate articles of the Declaration of London run counter to the doctrine of continuous voyage, or to its logical consequences, as applied to blockade. "A blockade," declared Article I, "must be limited to the ports and coasts belonging to or occupied by the enemy." "The blockading forces," said Article 18, "must not bar access to the ports or to the coasts of neutrals." And Article 19 declared further that "Whatever may be the ulterior destination of the vessel or of her cargo, the evidence of violation of blockade is not sufficiently conclusive to authorize the seizure of the vessel if she is at the time bound toward an unblockaded port."

The clauses quoted embody a distinct victory for continental nations—particularly for Germany, England's chief rival on the seas. They indicate that the Liberal government which sanctioned them was less clearly aware of true British interests than had been the government of Lord Russell's time, which, as shown above, had declined to interfere with the American practice. There was no lack of opposition to the declaration. The case against it, or against this portion of it, was succinctly stated in a resolution adopted by the Chamber of Shipping of the United Kingdom. The advantages of the declaration to neutral shipping, declared the resolution, "are far outweighed by the disadvantageous position in which it would leave this nation in regard to the vital question of the importation of food in the event of our being one of the belligerents. If we should be at war with a continental nation, foodstuffs coming to our shores in neutral vessels would be liable to interference and possible destruction, while our enemy would be at liberty to import foodstuffs even for the express purpose of supporting his army, by the simple device of having them transported in neutral ships to neutral ports and then importing them overland." [7]

[6] Parliamentary Papers. Miscellaneous. No. 4 (1909), p. 27.
[7] Nineteenth Century, Vol. 69, p. 411.

The bill for giving effect to the Declaration of London, though sponsored by the government and passed by the House of Commons, was eventually defeated in the House of Lords. At the outbreak of the war in 1914, therefore, the British Government faced three possible courses. First, it might put into effect the provisions of the declaration, which had received its own assent five years previously. Second, it might fall back upon American precedent which had been accepted by Great Britain in the '60's but in part repudiated in recent years. Third, taking the American usage as its starting point, it might carry belligerent claims to a fullness as yet unapproached. What, as regards blockade, would be the practical working of each of these three courses?

If the first course were adopted and the Declaration of London taken as a guide, England's ability to halt German trade would be severely limited. All German ports, of course, might be blockaded, hermetically sealed if England had the power. This would inflict considerable hardship on Germany, but would leave untouched all trade (except in absolute contraband) which Germany might deflect through neutral ports and thence in neutral bottoms. Germany's position gave her excellent facilities for trade of this sort, which could be directed through Dutch or Danish ports or across the Baltic and by way of Sweden and Norway. Obviously there could be no effective stoppage of German trade by this means.

If, in the second place, England adopted American precedent as her rule, her position would be not greatly improved. The only type of case exactly covered by the American usage would be that in which a neutral vessel was found with goods for Asterdam, let us say, which it could be shown were later to be carried *by water* to a blockaded German port. If the carriage were to be by land, then the principle laid down in the *Peterhoff* case would prevent any interference.

The only course, then, which gave promise of large results was an extension of the American policy. The decisions in the cases of the *Bermuda*, *Springbok*, and *Peterhoff* had established the ultimate rather than the immediate destination of a cargo as the criterion of its character, but had clung to the old conception of a blockade as applicable only to ports and seacoasts. That is, an enemy destination was legitimate for non-contraband goods provided the last leg of the journey was to be by land. The great

difficulty of land transport from Mexico had made the distinction easy to observe during our Civil War. The World War afforded the first case in which the development of railway transportation threatened to nullify the effects of a seacoast blockade. In the face of this new situation, could the old distinction be maintained?

Events answered in the negative. For some months, indeed, England abstained from any kind of blockade, declaring a tentative adherence to the provisions of the Declaration of London and relying, for the stoppage of German trade, upon the shutting up of German ships and wide extension of the contraband lists. How long, barring special provocation from Germany, she might have pursued this policy it is impossible to say, but she was quick to take advantage of the initiation of the submarine blockade as a justification for drastic change in her own methods.

On March 1, 1915, a note to neutral powers declared that henceforth the British and French Governments would "hold themselves free to detain and take into port ships carrying goods of presumed enemy destination, ownership, or origin. It is not intended to confiscate such vessels or cargoes unless they would otherwise be liable to condemnation."[8] The significance of this note was further clarified by an Order in Council of March 11.[9] "No merchant vessel which sailed from her port of departure after the 1st March, 1915, shall be allowed to proceed on her voyage to any German port. . . . No merchant vessel that sailed from any German port after the 1st March, 1915, shall be allowed to proceed with any goods on board laden at such port. . . . Every merchant vessel which sailed from her port of departure after the 1st March, 1915, on her way to a port other than a German port, carrying goods with an enemy destination, or which are enemy property, may be required to discharge such goods in a British or allied port." Such goods, if not contraband, it is provided, may be restored at the order of the Prize Court and on the terms it indicates, to their proper owners.

The declaration of this policy brought protests from neutral governments. Replying to that of the United States, Sir Edward

[8] Parliamentary Papers. Miscellaneous. No. 6 (1915). Communication No. 10.

[9] Manual of Emergency Legislation. Supplement No. 3, pp. 513–5.

Grey, in a note of July 23, 1915, stated the justification of the British Policy.

His Majesty's Government are unable to admit that a belligerent violates any fundamental principle of international law by applying a blockade in such a way as to cut off the enemy's commerce with foreign countries through neutral ports if the circumstances render such an application of the principles of blockade the only means of making it effective. . . . A blockade limited to enemy ports would leave open routes by which every kind of German commerce could pass almost as easily as through the ports of her own territory. . . . It seems accordingly that, if it be recognized that a blockade is in certain cases the appropriate method of intercepting the trade of an enemy country, and if the blockade can only become effective by extending it to enemy commerce passing through neutral ports, such an extension is defensible and in accordance with principles which have met with general acceptance. . . .

What is really important in the general interest is that adaptations of the old rules should not be made unless they are consistent with the general principles upon which an admitted belligerent right is based. It is also essential that all unnecessary injury to neutrals should be avoided. With these conditions it may be safely affirmed that the steps we are taking to intercept commodities on their way to and from Germany fully comply. We are interfering with no goods with which we should not be entitled to interfere by blockade if the geographical position and the conditions of Germany at present were such that her commerce passed through her own ports. We are taking the utmost possible care not to interfere with commerce genuinely destined for or proceeding from neutral countries. Furthermore, we have tempered the severity with which our measures might press upon neutrals by not applying the rule which was invariable in the old form of blockade, that ships and goods on their way to and from the blockaded area are liable to condemnation.[10]

It is instructive to compare this argument with the opinion of Chief Justice Chase in the *Peterhoff* case, as quoted above. "Such trade," he had said, "with unrestricted inland commerce between such a port and the enemy's territory, impairs undoubtedly and very seriously impairs the value of a blockade of the enemy's coast. But in cases such as that now in judgment, we administer the public law of nations, and are not at liberty to inquire what is for the particular advantage or disadvantage of our own or another country." The idealist, no doubt, will exclaim that Chase is right, Grey Jesuitical. Yet let us remember two things. First, as has already been remarked, circumstances made it easy for Chase to be virtuous in the upholding

[10] Parliamentary Papers. Miscellaneous. No. 14 (1916).

of international law where it made against his country's interests; Grey's argument was written in a time of the gravest national peril. Second, can any one deny that international law, like municipal law, is fluid, changing with changing conditions? The importance of the changing conditions here involved had been pointed out in an earlier note of Sir Edward Grey's: "The advent of steam power has rendered it as easy for a belligerent to supply himself through the ports of a neutral contiguous country as through his own, and has therefore rendered it impossible for his opponent to refrain from interfering with commerce intended for the enemy merely because it is on its way to a neutral port."[11] Let us suppose, first, that transportation from Matamoras to the heart of the Confederacy had been as quick and easy as from Amsterdam to the heart of Germany; second, that our government in 1862 had been, like England in 1915, in a position to back up its policy with ample force against protesting neutrals—is there any doubt that we should have carried the doctrine of continuous voyage as far as England carried it in the World War?

The policy thus announced and explained England and her allies carried out with little change to the close of the war. On July 7, 1916, the Declaration of London, which had been tentatively accepted at the beginning of the war and widely modified thereafter, was formally set aside, and it was declared to be the intention of His Majesty's Government "to exercise their belligerent rights at sea in strict accordance with the law of nations." Among the principles which England undertook to recognize as a part of the law of nations, as declared in this same Order in Council, was the following: "The principle of continuous voyage or ultimate destination shall be applicable both in cases of contraband and of blockade."[12]

The rule thus stated might be taken as almost an epitome of American Civil War theory and practice. Its one point of advance was extremely important but entirely logical. We had declined to interfere with trade passing into the Confederacy by way of Mexico. England not only interfered with but practically destroyed trade passing into Germany by way of Holland, Denmark,

[11] Parliamentary Papers. Miscellaneous. No. 6 (1915). Communication No. 4.

[12] Solicitors' Journal & Weekly Reporter (London). Vol. 60, p. 622.

Norway, and Sweden. England took the one step we had declined to take. But in taking it she based her policy upon our Civil War precedent quite as logically as the latter had been based upon British precedent in the Napoleonic Wars. Taking the British doctrine of continuous voyage, which originally had not applied to blockade at all but to prohibited trade between a belligerent nation and her colonies, we made of it a justification for seizing ships and goods bound for a neutral port, Nassau, whence the goods were to be transported *by sea* to a blockaded port. At Matamoras we stumbled at the threshold of a much more drastic application of the doctrine, stumbled and then drew back. In our seizure of the *Peterhoff* we came strikingly near the theory that we might seize neutral ships and goods bound for a neutral port whence the goods were to be transshipped *by land* to a belligerent lying behind a blockaded coast. We did not declare, we ultimately repudiated, that doctrine. It remained for the British to carry the doctrine of continuous voyage to its logical conclusion, that is, to apply it not only to goods destined to pass eventually through the blockaded ports of an enemy, but to goods destined to pass the enemy border at any point whatsoever. The stone which our builders rejected became the corner stone of the British blockade.

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TRANS-PACIFIC COMMUNICATION[1]

By LIEUT. COMMANDER FRANK LUCKEL, U. S. Navy

It may be stated that the development of trans-oceanic cable and radio communication goes hand in hand with the development of commerce. Accepting this statement we can readily discover the underlying reason for the present insistent public demand for more adequate communication across the Pacific. The trans-pacific trade from the western ports of the United States and Canada has increased very rapidly during recent years. In the further development of this commerce rapid and dependable communication would be of the greatest assistance. Ordinarily we would expect the development of communication to keep pace with the growth of commerce. In this case the great expansion of our merchant marine and consequent or attendant increase in foreign trade has taken place in spite of inadequate communication facilities.

At present there are no less than twenty-two submarine cables across the Atlantic. Across the Pacific there are but two and only one of these terminates in a United States port. While the recent rapid development of trans-oceanic radio communication has drawn the interest and support of the public, nevertheless, the submarine cable is probably here to stay. The cable has a certain advantage in secrecy that cannot be attained by any means of radio communication with which we are at present familiar. In the matter of trans-pacific radio facilities a like preponderance exists in favor of trans-atlantic circuits. While there are a number of stations operating to afford reliable radio communication with Europe there are only two circuits operating in trans-pacific radio communication.

[1] This article was submitted for publication November, 1919.

As the trans-pacific cables preceded and influenced the development of our radio circuits we will first take up the submarine cables. By far the most important, at least so far as the United States is concerned, is the Commercial Pacific Cable. This is laid from San Francisco to Guam with intermediate stations at Honolulu and the Midway Islands. At Guam this cable connects with three cables. One is the extension of the Commercial Pacific Cable to Manila and from there to China. The second is the Commercial Pacific Cable to the Ogasawara Islands where it connects with the Japanese system through the Japanese cable station. The third branch is the ex-German cable to the important cable station on the Island of Yap. From Yap this cable extends in two lines, one to China and the other to the East Indies. We see that this cable is of great importance furnishing, as it does, communication with the Hawaiian Islands, Guam, the Philippines, and China, and, through connecting lines, providing communication to the East Indies and Japan.

The second cable is the British line from Vancouver to Brisbane with intermediate stations on the Fanning, Fiji, and Norfolk islands. At Brisbane this cable connects with the Australian Telegraph System. Through this, land wire connection is obtained with other cables running to the East Indies and the Orient. While this cable is relied upon for communication with Australia, it does not furnish direct communication with the Orient.

The business men and commercial organizations of the Pacific Northwest are manifesting considerable interest in the possibility of the government laying a cable across the North Pacific. Considering cables in connection with steamship routes it would appear that such a cable should be laid. At the present time the bulk of our trade with the Orient is carried in vessels sailing from Puget Sound ports. Messages for Japan cannot be filed in Seattle. These must be filed by an agent in San Francisco or vicinity and go by the roundabout way of Honolulu and Guam. Should this government cable be laid, one intermediate cable station would be necessary and would in all probability be located at some place in the Aleutian Islands. The cable would presumably be laid along the bank that extends for some distance south of these islands. One length would be from Seattle to this projected Aleutian Island cable station and the other would be laid from there to some place in northern Japan or the mainland of Asia.

Owing to the shortening of the degrees of latitude in the North Pacific this cable would only be about one-half as long as the present cable to Japan. The location of the present or prospective naval radio stations should determine the exact location of this proposed Aleutian Island cable station. These islands have many excellent sites and the climate is relatively mild.

Turning our attention now to trans-pacific radio communication we find this closely allied with the cable routes. Paralleling the Commercial Pacific Cable we have the high power naval radio stations. It was probably originally hoped that San Francisco or San Diego would be able to work Cavite with one relay at Pearl Harbor. With this end in view 350 kw. arc stations were installed at Pearl Harbor and Cavite. In the practical operation of this circuit it was found either necessary or desirable to relay practically all traffic between Cavite and Pearl Harbor through the 30 kw. arc set at Guam.

Cavite works Guam by means of storage batteries. The present station at Guam is not particularly well adapted for distant control but it is naturally well located for the transmission and reception of signals and has done good work. With the installation of a higher powered set at Guam considerable improvement should result. The installation of a 100 kw. arc set at Mare Island will be a step in the same direction. The distances between these radio stations are approximately as follows:

San Francisco to Pearl Harbor	2091 miles.
Pearl Harbor to Guam	3337 miles.
Guam to Cavite	1500 miles.

In connection with the increase in power at Guam the question of the advantages of higher powered stations over more stations having less power may be considered. The establishment of a few very high powered stations does away with a certain number of relays. However it adds to the difficulty of maintaining communication inasmuch as the power must be increased directly as the square of the distance between the stations. With the increased atmospheric disturbances and absorption losses in the tropics there appears to be an added disadvantage in working over great distances unnecessarily. While the present tendency is toward increases in power there are, nevertheless, substantial advantages in favor of the medium powered set with consequent more numerous relays.

Government traffic is sent from San Diego to Pearl Harbor but commercial traffic is sent from San Francisco. Commercial traffic may be filed at any place in the United States for the Hawaiian Islands, Guam, the Philippines, Tutuila, Apia, and Papeete. Traffic to Guam, Tutuila, and Apia is sent direct from Pearl Harbor. Traffic to various parts of the Hawaiian Islands is sent by the Inter-Island Radio System from Pearl Harbor. Messages to Papeete are relayed via Apia. Messages to the Philippines go to Cavite via Guam. At Manila these are turned over to the Bureau of Posts Telegraph System for delivery to the various islands.

Commercial radio traffic to Japan can only be filed in San Francisco or one of the bay cities, such as Oakland, Berkeley, or Alameda. This is in accordance with an agreement insisted upon by the Japanese Government. These messages are sent to Pearl Harbor and from there direct to the 200 kw. spark station at Funabashi. From there they are distributed by the Japanese telegraph system. The ruling of the Japanese government which requires all traffic to originate in San Francisco or vicinity works a hardship upon firms having no branch offices in San Francisco.

Another possible trans-pacific circuit is composed of the interesting Marconi stations at Bolinas and Kahuka. The Kahuka station is located on the Island of Oahu diagonally opposite from Pearl Harbor. The entire station is erected upon very extensive lines. The natural features appear to be adverse, inasmuch as the station is over a coral formation having the appearance of concrete. There are two characteristic Marconi antennæ systems each being supported between too long rows of steel masts. One system extends in a direction favorable for communication with Japan while the other is favorable for working Bolinas. The amount of space occupied by the condensers of this set can be imagined when we consider that it is rated as having a 350 kw. spark. While these stations were closed during the war the circuit has certain potential possibilities.

The ex-Federal Telegraph 60 kw. station at Heeia is located on the shore about half way between Pearl Harbor and Kohuka. This station was partly dismantled to provide apparatus for building the Russian Island station. It has since been placed back in service to relieve the congestion at Pearl Harbor. It is especially well located so far as natural features are concerned and may be expected to continue to do good work as in the past.

With the cable and radio systems laid out so as to have radio stations near the corresponding cable stations we have the advantage of permitting one system to handle the traffic during a failure of the other. Thus in case of a cable break between Guam and Manila all cable messages from San Francisco to Manila would go by the cable to Guam and then by radio to Cavite. In case of a failure of a naval radio station, traffic would be handled by the cable in a similar manner. Cable breaks become increasingly frequent as the cable becomes older. They usually take place in a locality where the cable is subject to chafing over a rocky bottom. The cable through San Bernardino Straits between Manila and Guam is noted for the frequency with which it is broken. The tide through these straits flows at an eight knot rate and the bottom is very uneven and rocky.

During the recent cable breaks the navy bridged the gap but all messages were subject to great delay. While the story about the Seattle man having received a confirmation before he received the actual cablegram may have been an exaggeration yet delays up to 14 days were not unusual.

In any case of continued delay it is but natural to expect the greatest congestion to be at some intermediate point, in this case Pearl Harbor. The reasons for this are two. First, local traffic to or from the intermediate point. To illustrate this we will suppose that two messages originate in Honolulu, one for Japan and the other for the United States. It is readily seen that Pearl Harbor must operate twice, once to transmit to Funabashi and once to San Francisco. In other words Pearl Harbor in handling messages destined to or originating at local points must work as much as all connecting stations combined. Second, we have relayed traffic. An intermediate relaying station does as much work in handling through traffic as both terminal radio stations combined. Thus in case a message were to go from Funabashi to San Francisco via Pearl Harbor and return it can be readily seen that this message would be handled as often by Pearl Harbor as by San Francisco and Funabashi combined.

At the present time there is in process of evolution a second trans-pacific radio circuit that closely parallels the proposed Northern Pacific Cable System. This is composed of the U. S. Naval Radio Stations at Keyport, Cordova, St. Paul, and Russian Island. The 30 kw. arc set at Keyport is distant controlled from

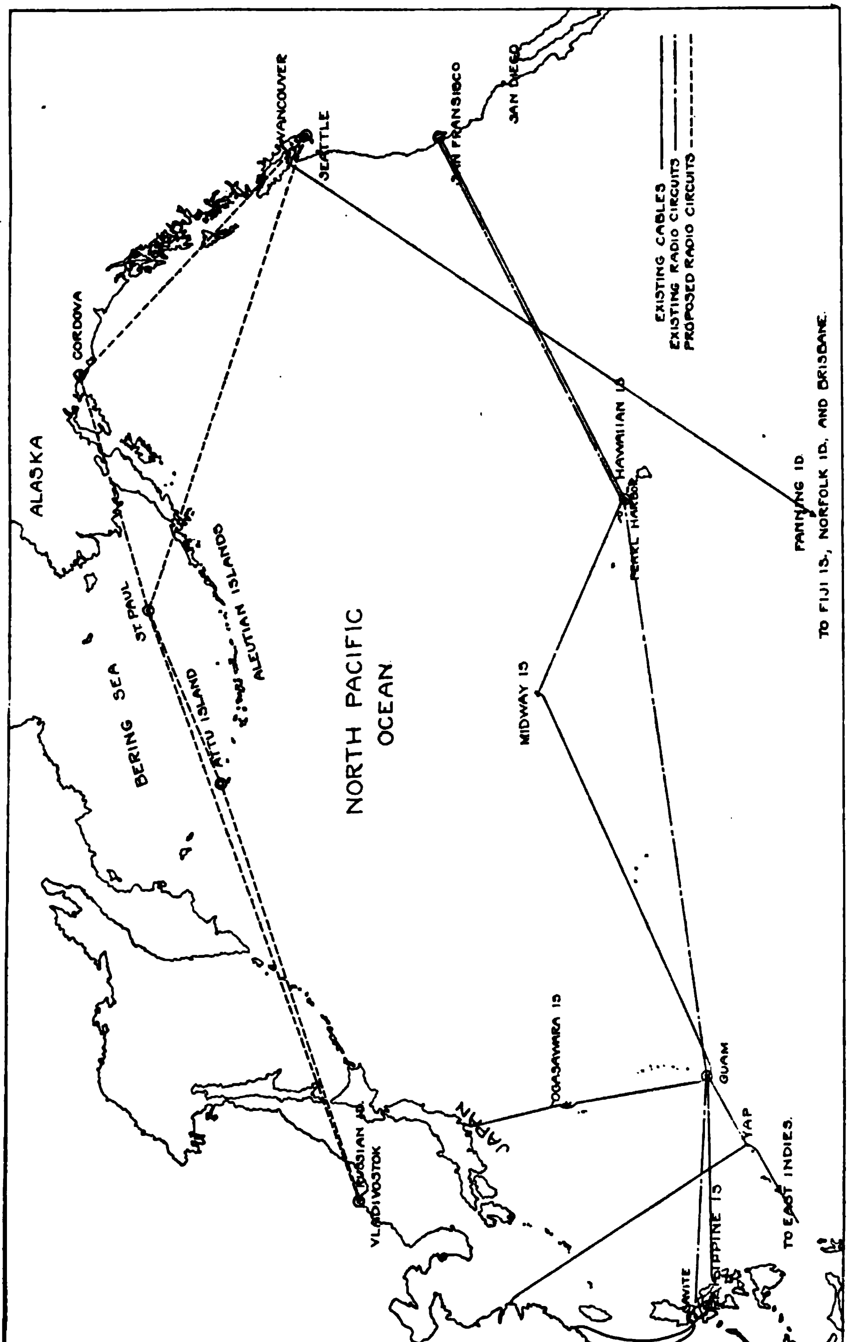
the Navy Yard, Puget Sound. The 30 kw. arc set at Cordova is located near the Copper River Flats and is distant controlled from a station seven miles away. The St. Paul station has recently had a 30 kw. arc set installed. St. Paul is considered by many to have the best natural location of any radio station in the world. The character of the soil and surrounding water appears to be very favorable to the reception and transmission of signals. It is located in a belt practically free from static and atmospheric disturbances and there is no high land on the island. Geographically it is located so far north as to take full advantage of the reduced absorption and converging meridians of the Polar Regions. It is also so located as to permit communication with vessels crossing the Pacific on the Northern Great Circle course. The Russian Island station is located on Russian Island about 13 miles in an air line from Vladivostok. The Russians started the construction of this station but it was completed by the navy. It does not appear to be located to best advantage and the masts were not well adapted for the antennæ of the 60 kw. set that was installed. On the whole it probably has not come up to expectations.

The reasons that make it desirable to lay a cable across the Northern Pacific are also good arguments for the existence of a radio circuit. The radio stations have an additional argument in their favor as they will also provide for communication with vessels following the great circle course across the Northern Pacific. This course takes them very near the Aleutian Islands so that the advantage of having radio stations in that vicinity is apparent. While Cordova is included in this circuit it should be practicable to work St. Paul direct from Puget Sound. The following approximate figures show the advantages this circuit would have in reduced distances:

Keyport to Cordova	1200 miles.
Cordova to St. Paul	700 miles.
St. Paul to Russian Island	2300 miles.

If messages were sent direct to St. Paul from Puget Sound these distances would be still further reduced.

The above outlined circuit has handled a limited amount of traffic but it cannot be considered as in practical operation. It appears probable that before reliable communication is obtained it will be necessary to either increase the power or else add one more medium powered station to the chain. Should this latter course


EXISTING CABLES
EXISTING RADIO CIRCUITS
PROPOSED RADIO CIRCUITS
ALASKA
CORDOVA
VANCOUVER
SEATTLE
SAN DIEGO
HAWAIIAN IS
FANNING ID
TO FIJI IS, NORFOLK ID, AND BRISBANE
BERING SEA
ST PAUL
ALEUTIAN ISLANDS
ATTU ISLAND
NORTH PACIFIC OCEAN
MIDWAY IS
OGASAWARA IS
GUAM
YAP
TO EAST INDIES
JAPAN
VLADIVOSTOK

be adopted the Island of Attu would provide an excellent site for this future station. In the evolution of this radio circuit the St. Paul radio station exercised a considerable influence. Several years ago St. Paul found little difficulty in copying Otchishi, Anadyr, and Petropavlovsk. The Japanese government desired to exchange daily weather reports through St. Paul. Several tests were arranged between the Japanese station at Otchishi and St. Paul. Although these tests were unsuccessful in the days when St. Paul had only a 5 kw. spark set it was hoped that the installation of the new 30 kw. arc would overcome the difficulty. So far the hoped for success has not been completely attained.

Another possible trans-pacific circuit has been outlined by the Officer in Charge, Washington-Alaska Military Cable and Telegraph System. His plan is to make use of the present Army Cable Telegraph and Radio System as far as Nome and from there route traffic to the Russian radio station at Anadyr, about 450 miles away. While this plan does not appear practicable, especially at the present time, still it is an interesting possibility.

In the above discussion it may appear that the importance of the submarine cable has been somewhat exaggerated at the expense of radio. In the development of these two means of trans-oceanic communication neither should be developed independently of the other. They should go forward hand in hand. Any advance made by one is certain to help the other. These two systems are so dissimilar that it is very improbable that both would be placed out of commission by the same catastrophe. In the south the radio system was built to parallel the cable. In the north these conditions will be reversed. Any cable that is laid there in the future will have its route influenced by the radio circuit that is at present in course of evolution.

DISCUSSION

Accuracy of Fire at Long Ranges

(SEE PAGE 1175, WHOLE NO. 210)

Reference: (a) "Retrospect upon Japan-Russia War," Mahan, 1906

CAPTAIN W. P. CRONAN, U. S. Navy.—Captain Chase has done more than set forth with clarity an interesting essay on gunnery—he has again laid before us the *N* square law, which is refreshing to the mind and therefore thought provoking. His ultimate deductions pertain to ordnance questions, but his train of thought has properly proceeded from tactics first, to gunnery, thence, logically to decisions on ordnance design. Somewhat like this:

First. What do we want to do?

Second. How are we going to do it?

Third. What can we do it with?

Now I propose, using this essay of Captain Chase's as material, to work back the other way and see if we can derive a strategic lesson from the arguments before us. Well, accepting his deductions, and disregarding intermediate reasoning, we are confronted with his premises, which are tactical and based on the "*N* square law," which we may accept on the authority of Captain Chase, corroborated as it is by independent English research. It may here be conveniently re-stated as follows: "Advantage is measured, not by the ratio of the number of the opposing ships actually engaged, but by the square of this ratio." This assumes opposing ships to have equal hitting power.

In tactics we deal with the disposition of a fleet approaching to battle, and, in so far as gunnery is concerned, actually in battle.

In strategy we deal with the disposition of a fleet before battle, and in preparation therefor. It appears to be true, other things being equal, that the *N* square law, as potential force, obtains here as well as in tactical contact, in gunnery. Assuming this to be true, let us examine the available potential strength of one fleet, in the light of the law, which, strategically applied, points clearly to the necessity for concentration, in order that *N* may have its greatest value. From an examination of the Navy Directory, August 1, 1920, we find that we have available for use in the main body of a fleet, vessels of the first line (excluding *South Carolina* and *Michigan*) to the number of sixteen (16) (including *Tennessee*, not yet ready).

In conformity with the *N* square law, the potential strength of these sixteen (16) ships, as a main body, may be expressed numerically for comparative purposes as the square of 16, or, 256. This is true only when these 16 ships are concentrated in one body. "War is a business of positions,"

said Napoleon; by that he did not mean geographical position, but concentration of force, which Mahan (ref. a) defines as "being itself a choice of position, viz.: that the various corps, or ships, shall not be some in one place, and some in others, but all in one place." Mahan goes on to point out the terrible price paid by Russia in the war with Japan, for failure to observe this fundamental of strategy—since then we have seen the British Fleet assembled under one command by an able and far-seeing First Sea Lord, with opposite results.

On further examination of our Navy Directory we find that our capital ships are divided into two main bodies, in two fleets, one in the Atlantic and one in the Pacific. There are eight capital ships in each fleet (assuming *Tennessee* in the Pacific). The potential strength of each main body may be expressed as the square of 8, or 64, following our previous assumption. If these two main bodies were combined, the resultant strength would not be double that of each of the original main bodies, but, following the N square law, would be an increase in the ratio of 64 to 256, or four times greater than the strength of each of the smaller separated main bodies.

This principle applies to other types as well.

With 16 ships in the main body of one fleet, periodic overhaul and repair of one division at a time is possible without undue weakening of the fleet; for, on reduction to 12 units, the resultant strength, as compared with the present main bodies of 8 each (full strength) in 2 fleets, would be increased from $(n=8)^2=64$ to $(n=12)^2=144$.

This principle also applies to other types.

Other factors, of course, enter into the disposition of the fleet, but following the cogent reasoning of Mahan (ref. a) in which he warns us of the danger in violating the principle of concentration (and this he does in capital letters), and the further consideration of the principle of unity of command with resulting unity of doctrine, it will be seen that the purely mathematical reasons for concentration are augmented by strategic principles. With these, however, I am not concerned; on the mathematical analysis I rest my case.

MINUTES OF ANNUAL MEETING, 1920

U. S. NAVAL ACADEMY, ANNAPOLIS, MD.,
OCTOBER 8, 1920.

In accordance with Article V, Section I of the Constitution, two weeks' notice having been given, the annual meeting was held in the Board Room of the Officers' Mess.

Captain W. T. Cluverius, U. S. Navy, Chairman of the Board of Control, presided.

The minutes of the last meeting were read and approved.

The first and stated business being the election of officers, the following tellers reported the vote, having been appointed by the Vice-President 10 days previous—

Commander Abram Claude, U. S. Navy.
Commander F. D. Pryor, U. S. Navy.
Lieut. Commander Rufus King, U. S. Navy.

The tellers reported the results of the election as follows:

For President

Rear Admiral B. A. Fiske, U. S. N.	591
Rear Admiral H. S. Knapp, U. S. N.	183
Rear Admiral W. H. G. Bullard, U. S. N.	171
Admiral A. P. Niblack, U. S. N.	110

For Vice President

Rear Admiral A. H. Scales, U. S. N.	1019

For Secretary and Treasurer

Commander H. K. Hewitt, U. S. N.	845
Commander W. L. Friedell, U. S. N.	183

For Board of Control

Captain W. T. Cluverius, U. S. N.	808
Captain E. J. King, U. S. N.	729
Captain W. G. DuBose, U. S. N.	717

Captain T. L. Johnson, U. S. N	655
Captain A. Bronson, U. S. N	615
Commander B. C. Allen, U. S. N	595
Commander A. P. Fairfield, U. S. N	437
Commander J. O. Richardson, U. S. N	413
Brig. Gen. George Richards, U. S. M. C	402
Commander C. R. Hyatt, U. S. N	271
Commander E. A. Cobey, U. S. N	232
Commander G. H. Bowdey, U. S. N	193
Scattered votes	31

The following officers were then declared elected:

President

Rear Admiral B. A. Fiske, U. S. Navy.

Vice President

Rear Admiral A. H. Scales, U. S. Navy.

Secretary and Treasurer

Commander H. K. Hewitt, U. S. Navy.

Board of Control

Captain W. T. Cluverius, U. S. Navy.
Captain E. J. King, U. S. Navy.
Captain W. G. DuBose (C. C.), U. S. Navy.
Captain T. L. Johnson, U. S. Navy.
Captain A. Bronson, U. S. Navy.
Commander B. C. Allen, U. S. Navy.

The vote on the following amendments to the Constitution was then considered:

AMENDMENT NO. 1

ART. III. Change period to comma and add "or in such other place as the Board of Control may select," making the article read as follows:

"The headquarters of the Institute shall be at the United States Naval Academy, Annapolis, Md., or in such other place as the Board of Control may select."

AMENDMENT NO. 2

For ART. VI, SECS. 1, 2 and 3, which now read as follows:

SECTION 1. The President shall preside at business meetings of the Institute at which he may be present.

SEC. 2. In the absence of the President, the Vice-President shall preside.

SEC. 3. The Board of Control shall consist of seven members in good standing, regular or life, and its duties shall be the management of all the

financial and administrative business of the Institute, including the censorship, printing, and control of its publications. The Secretary and Treasurer shall be, *ex officio,* a member of the Board, its medium of communication, and the recorder of its transactions. Regular meetings of the Board of Control shall be held when called by the Secretary and Treasurer, and he shall issue a call for a special meeting at any time upon the written request of two members of the Board. A quorum shall consist of three members. In the absence of both the President and Vice-President at business meetings of the Institute, a member of the Board of Control shall preside. It shall be the duty of this Board to appoint a committee of three of its own members to audit and certify the books and accounts of the Secretary and Treasurer once every year.

Substitute new sections as follows:

SECTION 1. The President shall preside at meetings of the Institute and of the Board of Control at which he may be present.

SEC. 2. In the absence of the President, the Vice-President shall preside. In the absence of both the President and the Vice-President the Senior member present of the Board of Control shall preside.

SEC. 3. The Board of Control shall consist of nine members, of whom the President, Vice-President and the Secretary and Treasurer shall be members, *ex officio,* the other six shall be members in good standing, regular or life. The duties of the Board of Control shall be the management of all the financial and administrative business of the Institute, including the censorship, printing, and control of its publications. The Secretary and Treasurer shall be its medium of communication, and the recorder of its transactions. Regular monthly meetings of the Board of Control shall be held when called by the Secretary and Treasurer, and he shall issue a call for a special meetings at any time upon the written request of two members of the Board. A quorum shall consist of four members. It shall be the duty of this Board to appoint a committee of three of its own members to audit and certify the books and accounts of the Secretary and Treasurer once every year.

AMENDMENT NO. 3

ARTICLE 7, Section 4.

For second sentence, which now reads:

"The Secretary of the Navy shall be, *ex officio,* an honorary member."

Substitute.

"The Secretary and Assistant Secretary of the Navy shall be, *ex officio,* honorary members."

AMENDMENT NO. 4

ARTICLE 7, Section 9.

Strike out the last sentence which reads:

"Members in arrears more than three years may, at the discretion of the Board of Control, be dropped for non-payment of dues."

Add new Section 10 to read as follows:

Section 10. Members in arrears more than three years may, at the discretion of the Board of Control, be dropped for non-payment of due. Membership continues until a member has been dismissed, dropped, or his resignation in writing has been received.

The tellers reported the vote on the amendments as follows:

	AMENDMENT NO. 1		AMENDMENT NO. 3
For	865	For	928
Against	100	Against	38

	AMENDMENT NO. 2		AMENDMENT NO. 4
For	957	For	962
Against	7	Against	4

All the proposed amendments were declared adopted.

The Secretary and Treasurer presented his annual report as follows:

1. The cost of print paper, printing, and binding has increased so greatly during the year that the PROCEEDINGS now cost over forty cents per copy to publish, exclusive of office operation cost. A member pays twenty-five cents a copy, and a subscriber about twenty-nine cents. Furthermore, the present stock of paper, purchased in 1918 will be exhausted with the November number. The new paper will represent an increase in cost of 105% over the old and will increase the cost of publishing the PROCEEDINGS by about 50%.

2. The profits from the Book Department are kept as low as practicable. They, together with interest on investments, will not begin to cover the loss in the publication of the PROCEEDINGS, which amounts to about $1800.00 per month. The courses open are, (a) to increase the dues; (b) to cut down the size of the PROCEEDINGS or publish less frequently; (c) to stand the loss. In view of the fact that the present surplus is $169,298.15, the Board has decided to stand the loss for the present, in the hope that conditions may become more normal later on.

3. There are at present 5272 members, of which 4 are honorary members, 141 life members, 4613 regular members and 514 associate members. Of these the PROCEEDINGS for 1504 members have been stopped, owing to the fact that either they have not advised the Institute of changes of address, or that they are in arrears in dues for two or more years.

4. The changes in membership during the year were as follows:

Resignations—		
Regular	224	
Associate	26	
		250
Deaths—		
Regular	30	
Associate	5	
Life	3	
		38
Dropped—		
Regular	201	
Associate	1	
		202
Total loss in Membership		490
New members		180
Net loss in Membership		310

5. The large number of reserve and temporary officers who decided to discontinue membership upon their return to civil life, accounts for the number of resignations. Many such officers joined under the impression that they were merely subscribing to a magazine. They failed to forward their addresses upon change of station and return to civil life, and in many cases paid no dues after the first year. This explains the large number of members shown to have been dropped for non-payment of dues.

6. It is planned to undertake an active membership campaign among officers of the regular service, all of whom should belong to the Institute, and among all officers in the Reserve Force in order to keep up their connection with the service and stimulate their interest therein.

7. The following Institute publications have just been revised or are now under revision:

Steam Turbines,
Marine and Naval Boilers,
Mechanical Processes,
Practical Manual of the Compass,
Naval Ordnance.

At the suggestion of the War College, the Institute is reprinting "War on the Sea" and certain extracts from "Genius of Naval Warfare" in one volume.

A new book "Elementary Mechanics" has just been published for the Department of Mathematics and Mechanics at the Naval Academy.

The prices of practically all books recently had to be raised to conform to the increased publication cost.

8. A very complete "General Index" to the PROCEEDINGS, Numbers 101 to 200 inclusive, is being prepared and will in all probability be ready for issue early in 1921. This will include matters of importance in the Professional Notes, as well as the articles in the body of the PROCEEDINGS.

The report of the Secretary and Treasurer was adopted.

There being no further business the meeting adjourned at 8.20 p. m.

H. K. HEWITT,
Commander, U. S. Navy,
Secretary and Treasurer.

U. S. NAVAL INSTITUTE

SECRETARY'S NOTES

Membership Life, regular and associate membership, 5298
New members: 11. Resignations: 3.

Dues The annual dues ($3.00) for the year 1920 are now payable.

Regular and associate members of the U. S. Naval Institute are subjected to the payment of the annual dues until the date of the receipt of their resignation.

Discussions Discussion of articles published in the PROCEEDINGS is cordially invited. Discussions accepted for publication are paid at one-half the rate for original articles, or about $2.25 a page.

Address of Members *All members are urged to keep the Secretary and Treasurer informed of the address to which* PROCEEDINGS *are to be sent, and thus insure their receipt.* Members and subscribers are urged to notify the Secretary and Treasurer promptly of the non-receipt of PROCEEDINGS, in order that tracers may be started. The issue is completed by the 15th of each month.

Book Department The Institute Book Department will supply any obtainable book, of any kind, at retail price, postage prepaid. The trouble saved the purchaser through having one source of supply for all books, should be considered. The cost will not be greater and sometimes less than when obtained from dealers.

Reprints of Articles The attention of authors of articles is called to the fact that the cost to them of reprints other than the usual number furnished, can be greatly reduced if the reprints are struck off while the article is in press. They are requested to notify the Secretary and Treasurer of the number of reprints desired when the article

is submitted. Twenty copies of reprints are furnished authors free of charge.

Illustrations Authors of articles submitted are urged to furnish with their manuscript any illustrations they may have in their possession for such articles. The Institute will gladly co-operate in obtaining such illustrations as may be suggested by authors.

Original photographs of objects and events which may be of interest to our readers are also desired, and members who have opportunities to obtain such photographs are requested to secure them for the Institute.

Notice Whole Nos. 6, 7, 10, 13, 14, 15, 17, 144, 145, 146, 147, 149, 155, 167 and 173 of the PROCEEDINGS are exhausted; there are so many calls for single copies of these numbers that the Institute offers to pay for copies thereof returned in good condition at the rate of 75 cents per copy.

ANNAPOLIS, MD., October 15, 1920.

INFORMATION INDEX

PROFESSIONAL NOTES

PREPARED BY

LIEUT. COMMANDER H. W. UNDERWOOD, U. S. Navy

GENERAL ARRANGEMENT

FRANCE

LESSONS OF THE WAR.—*A French Admiral's Views.*[1]—In presenting Admiral Daveluy's opinions in a condensed form I have tried to lose as little as possible of their meaning and value. One or two purely French problems, which, it is thought, are of no interest to foreigners, have not been reviewed. Beyond a few prefatory remarks I have abstained from criticising, after the manner of newspaper experts, the work of a well-known officer. Probably some of the author's conclusions will be challenged by students of naval warfare. The book is obviously more a popular work, designed to instruct public opinion, than a treatise on strategy, and it is admittedly a book of generalizations; but it is rare to find a naval officer voicing his opinions in public print, and they become all the more interesting when stated dispassionately by a discerning foreigner. (British translation.)

Character of the War.—The war was of a disconcerting character. Material which had been prepared at huge cost was not used, and new material had to be created—a situation unprecedented in history. Germany least of all had had real confidence in submarines, yet it was submarines that reversed the order of things. Battleships had to play a preventive rôle only; history was repeated in the arming of merchant ships and the lining of the shores of France with small forts. The weapons of warfare had changed but not the principles. The sea is first and foremost a line of communication, to be wrestled for by belligerents. Up to the first months of 1915 the war was one of commerce; unbroken save by a few minor operations undertaken to give satisfaction to public demands. The Allies were clearing the seas of German commerce and commerce destroyers, and the Germans were trying to cut lines of communication.

The second phase saw Germany, her cruisers sunk, resort to increased use of submarines, while the Allies replied by barricading their main harbors and launching a swarm of small craft. The second phase was unfavorable to the Allies because it took them a long time to find weapons with which to combat the submarine employed in an inhuman manner. The total tonnage sunk by submarines was fourteen millions, and we cannot be said, although the newspapers affirmed it, to have had complete

[1] "*Les Enseignements Maritimes de la Guerre Anti-Germanique,*" Contre-Amiral Daveluy, Paris, 1919.

sovereignty of the seas while the submarine menace was at its worst. Nevertheless, it was when the menace was strongest that the American armies and their entire equipment crossed the sea in security. It is curious to note that the general public only began to realize the value of our navies when the latter had received some checks.

How might we have drawn greater benefits from our maritime superiority, and what shall France's future naval forces be? There are those who say that the submarine was the most successful engine of the war and that it should be the sole man-of-war of the future; but the surface vessel won the war, not the submarine. The nation which has an all-submarine navy will doubtless be able to inflict huge commerce losses, but will not herself possess the right of way of the sea. Why did the submarine fail to gain liberty at sea for Germany? Because its power is so very limited. It has the one great quality of invisibility, and but little more. It is slow, vulnerable on the surface, and requires selected conditions for its attack. How many times have ships passed safely by submarines because they were not in a favorable position for attacking? It is useless for commerce protection.

The fleet of the future must comprise surface craft and submarines, and, by examining the behavior of all kinds of surface craft and submarines, we can gain an idea as to which types should survive.

The Future of the Battleship.—What was expected of battleships? They were expected to keep the sea and finally to overcome, at the least by numerical superiority, the enemy's battle fleet. They were unable to keep the sea. Mines and submarines restricted thm to short and carefully planned cruises. Had there been a force of capital ships able to keep the sea, the great submarine campaign would never have begun, because a close blockade of German ports by our myriad small craft, backed by immediate support, would have nipped it in the bud.

Yet the Grand Fleet, even when lying at its base, made its power felt. It enabled England to surround her coasts with anti-submarine patrols which the Germans could not dislodge with submarines, and dared not attack with surface craft. The Grand Fleet, ever vigilant, was the great covering force of Allied commerce all over the world.

The German battle fleet even less fulfilled its mission than did those of the Allies. Held in check, it of itself could not oppose any of our operations, and, even after a tactical success, was obliged to run for harbor. Germany's position would have been better had she had no battle fleet, but had invested a corresponding sum of money in submarines.

We may conclude, therefore, that a nation which intends to dispute the control of the seas must have a force of surface capital ships, while a nation which foresees a defensive campaign will do well to place all her resources in submarines. A new type of battleship is required. The present-day dreadnoughts, direct descendants of three-deckers, are entirely built for the purpose of delivering and withstanding attack by gun-fire. Their vitals are at the mercy of mines and torpedoes, and they have no weapon with which to reach a submerged attacking vessel. Their present security above the water-line must to some degree be sacrificed to greater protection below. Their great draught renders it extremely difficult to localize the effect of an under-water penetration. It is probable that the future type will be heavily armored, but the real problem, and it is a very difficult one, is the reduction of draught.

Enormous ships are the outcome of rivalry between the first-class maritime powers, and it remains to be seen whether England and the United States will engage in a competition to outbuild each other. But it is not yet proven that a mammoth ship is better than two or three moderate ones.

We may be quite sure that the modern capital ship will be furnished with weapons against submerged approach, possibly in the shape of a number of light howitzers to throw plunging shells. Controlled from a kite-balloon (which every big ship will tow in the future), these howitzers would, on the detection of submerged approach, cover the sea in all directions with a rain of shells. As for dreadnoughts, their day is done.

The Necessity of Light Cruisers.—Light cruisers and submarines took the most active part in the war. The former were in great demand and had to fulfil many rôles. Even England, who possessed many, was nevertheless better off for battleships than light cruisers, and, had she been able to exchange some of her dreadnoughts for light cruisers, would still have found unceasing work for them; Germany felt the need of light cruisers; Italy, on her entry into the conflict, was careful to ask England for the services of four; as for France, she had none, and could not, therefore, assist to clear the seas of commerce destroyers.

How did France come to "commit the gross blunder" of leaving herself without light cruisers? By the close of the nineteenth century French naval experts had made a close study of scouting, which, they considered, was the whole and sole duty of a cruiser. Basing their opinions on fleet maneuvers, they came to the conclusion that the future naval action would take place in the following manner: The opposing battle fleets would put to sea in search of each other preceded by their respective cruiser arcs. When the arcs met, a cruiser action would ensue. The side with the more heavily armed cruisers would win and these would then be able to push on and gain exact knowledge of the enemy's battle-fleet strength and disposition.

France accordingly invented and built the armored cruiser. Other nations for a time imitated her, but soon abandoned this type of vessel. Not so France; with maternal pride she clung to her armored cruisers, maintaining that a vessel must be of at least 8,000 tons displacement if she is to keep her speed in all weathers. In other words, the light cruiser was condemned out of hand because it falls short of that absolute perfection which is beyond human attainment. In vain did a section of French officers, of whom the author was one, protest that war differs from maneuvers; that the varying circumstances of the one demand a flexibility which cannot be deduced from the formal pitched battles of the other; and that the supreme virtues of a cruiser force are adroit handling and a right use of high speed. Apart from its functions with the battle fleet, the light cruiser can perform many others for which an armored cruiser is unfitted. Their warning fell on deaf ears, and the war found France using, in place of light cruisers, vessels which came to be called by their crews "target ships."

Light cruisers were no more immune than battleships from losses due to submarines and mines, but they had to keep to the sea. No better proof can be found of the value of this type of vessel. They too must be transformed to meet submerged attacks, and it is desirable that their draught be reduced; perhaps we shall see a radical change in this direction. During the war destroyers were compelled to undertake work proper to light cruisers. There must be more light cruisers, many more; there will always be plenty of work for them, both those of 4,000 to 5,000 tons and the smaller types.

The Disappearance of the Surface Torpedo Craft.—By the end of hostilities the total number of torpedo craft engaged had become enormous, and all were hard worked. Thus it comes about that there are some impressionable people, even seamen, who think that more attention should be paid to the development of destroyer flotillas. Yet the destroyer was employed upon every service into which it could be pressed evcept that for which it was designed; how much more efficiently could it have dealt with the submarine menace had it been originally furnished with the weapons and endurance to do so. It was not until Jutland that destroyers ever had a chance to perform their grand rôle, and then they were baulked; Jutland was a play without a second act.

Destroyers will be replaced by vessels in which the torpedo will only be a secondary arm. Instead of carrying six, eight, or even ten tubes they will only carry two; they will have two or three 6-inch guns, and a special depth-charge armament. By reducing their speed to that of the flotilla leaders (*Arethusa* class), which always supported them in fleet movements, they may be given increased endurance and seaworthiness. The

degree of efficiency of the submarine torpedo craft relegates the surface torpedo craft to the rear rank.

The Success of the Submarine.—Before the war all the principal navies were interested in the future of submarines, but it was not until the *Aboukir-Cressy-Hogue* incident that the eyes of both sides were really opened to their possibilities. The influence of the submarine dominated the war; the story of the submarine is the story of the war in European waters. Yet it is the weapon *par excellence* of the weaker belligerent. Allied submarines, by the very fact of belonging to the stronger side, were denied the chance of achieving as much as they might have done; the Allies would have won the war even had they possessed no submarines, but, had Germany possessed none, the war at sea would not have lasted a year.

There was a lamentable lack of foresight in countering the submarine campaign. The Allies seemed to rest content with parrying each successive development when it had materialized, instead of anticipating it, which is the essence of strategy. France made grave mistakes in underrating the radius of activity of submarines, and in arming merchant ships with guns of too small caliber, mounted prominently, so that her ships became conspicuous in the days when neutrals were still respected. The correct answer to the German declaration of prohibited zones was the convoy system. Its inception rendered the arming of merchant ships superfluous.

Anti-submarine weapons may be divided into two classes: those which are local or limited in their employ, and those which are universal. Mines, nets, aircraft, guns, are of the former class, and while they do contribute towards the suppression of submarines, it is useless to rely wholly on them. Depth charges and mortars are of the latter class and no vessel should be without them. Every anti-submarine patrol boat of the future must be a small "mystery ship," indistinguishable from a merchant coaster. Sound-detection will one day be the means whereby submarines will be as surely tracked down as a criminal by a bloodhound, and that day will see them reduced to the level of every other kind of ship; that is, they will be invulnerable only in the presence of inferior force.

Steam-driven submarines stand condemned; they cannot dive quickly enough. France's boats were useless to her war policy because they possessed only defensive qualities.

Submarine navigation has certainly made great strides, and in the future we shall see submarines in the advanced cruiser arc, but not yet do they possess all the qualities of above-water craft; they cannot, therefore, displace them entirely. Those distinguished persons who insist that the future fleet should be all-submarine should remember that the war was not a fair test, firstly, because the submarine took us unawares, and secondly, because the world-wide nature of the war afforded it exceptional scope. Finally, it must be repeated that the power which places all her faith in submarines limits herself to the policy of merely opposing the offensive operations initiated by her enemies.

The War on Commerce.—In laying down a plan of campaign against England, foreign powers have always made the destruction of her commerce their ultimate object. This was, unlike other ones, a reciprocal war of commerce. Germany sought to diminish beyond the minimum the imports on which her island foe subsisted, while the Allies swept Germany's commerce from the seas and tried to deprive her of food and material which she could only obtain by sea. Notwithstanding the difficulty of seizing contraband which was carried in neutral bottoms between neutral ports (theoretically not contraband at all), the Alies are estimated to have held up 80 per cent of the contraband of war.

It is elementary truth that *guerre de course* (by surface ships) cannot seriously trouble England so long as she is mistress of the seas; nevertheless, it is once more proved that it creates a serious diversion, and it took many squadrons to round up the comparatively few German commerce destroyers—in fact, in November, 1914, we employed no less than 70 ships in this task. And how much greater would have been our difficulties if

Germany had possessed some dockyards abroad. The development of wireless telegraphy will greatly hamper commerce destruction in the future, as far as surface commerce destroyers are concerned, so that it would seem that surface vessels should only be deliberately employed for pure commerce destruction when, owning to their being cut off from support, there remains no other useful rôle for them to play.

Two special circumstances greatly enhanced Germony's success with *guerre de course:* (1) The war was almost world wide; (2) She had trampled under foot the rights of neutrals. These two conditions permitted her to sink at sight any vessel on the seas and they facilitated her submarine operations to a degree which is unlikely to prevail again. That is to say, sinking without hailing is unlikely to be a general condition of sea warfare again. The basis of commerce protection should therefore be the arming of merchant ships, but without neglecting every other anti-submarine device. But in areas where a submarine may presume any vessel met with to be an enemy vessel, the convoy system is preferable, the escort being provided by special anti-submarine vessels. These two methods of defence must be rigidly adhered to; they will vary with the future offensive and defensive qualities of the submarine.

Another special feature of the war was the dilemma of the neutrals. They could not do without British coal or American foodstuffs and so were obliged to preserve economic relations with the Allies and America. Having no power of defence they saw their commerce worse off than that of the Allies. This proves that every country should have a navy capable of assuring its economical integrity—even Switzerland!

Coastal Attack and Defence.—The mere coastal raid which has no military object is too futile to merit discussion. It is difficult to assess the full value of the continuous bombardment of the Belgian coast, but at least it provided a diversion while the land forces were operating.

The Dardanelles might possibly have been forced had not some of the prime rules of strategy been transgressed. There ought to have been one combined naval, aerial and military attack, and it should have been based largely on the element of surprise. The landings were made at places which were especially strongly held by the enemy. The *River Clyde* incident is worthy of mention as a novel and "surprise" method of landing troops.

The Dardanelles campaign illustrates once again the fact that, in a duel between forts and ships equally gunned, the latter are at a disadvantage as soon as they approach the former to such an extent that they encounter minefields and become subject to cross-fire. One or two lucky hits may completely disable a ship, but a fort is not out of action until every gun is accounted for.

No matter what the distance to be traversed by the attackers, the coastal bombardments of the future will be aerial, and, if the aircraft cannot proceed direct to their objective, they will be carried in ships. In future France's coast defences will be in the hands of the Ministry of Marine.

The Use of Mines.—Germany's gigantic efforts in world-wide mine-laying did not repay her to any great extent and were only just worth while. We shall be better able to deal with mines in the future. Men-of-war will be provided with gear to protect them against explosives, and convoys will be screened by high-speed mine-sweepers. The best port mine-sweep would seem to be a light-draft paddle-boat.

The Co-operation of Aircraft with the Navy.—Seaplanes have proved their worth in connection with a variety of naval undertakings such as the registration of gun-fire, the examination service, mine-sweeping, submarine-hunting, and, above all, extending the radius of utility of scouting cruisers. The employment of specially designed seaplane carriers, though useful in certain cases, such as bombardments, is not the last word on the subject of seaplane transport. That will be reached by inventing flying

boats which are capable of folding their wings like a bird. Every ship would then be able to carry a number, and special seaplane carriers would be superfluous. Flying-off platforms should give place to apparatus combining a wire stretched above and a rail running underneath the flying boat. Being seaworthy, the flying boat would, on its return from a flight, be hoisted from the water.

Dirigible airships were of no value as bombers once the incendiary shell had come into use, but, for reconnaissance and scouting, the Zeppelin has a great future. All species of aircraft can be used for mail and commercial services in peace time, and they should be ready for rapid conversion to war uses.

France's Future Navy.—It is to be feared, owing to the heavy cost of the war and the unlikelihood of another in the immediate future, that France must rest content with a second-class navy for some years. It ought, however, to be planned with a view to constituting it a part of the combined allied fleet of the future. France and her Allies can look forward to naval supremacy; her fleet should not, therefore, be an all-submarine one, but one which, besides being complementary to those of her Allies, will form the nucleus round which, in the days of prosperity to come, shall grow up her first-class navy.

Steam must give way to internal combustion engines; smoke is a very great obstacle to invisibility; rapidity of fueling and the protection of magazines will be greatly ameliorated when the change takes place.

Some attention should be paid to the possibility of camouflaging all men-of-war which carry out their usual duties singly, that is, not grouped in squadrons. It should be made difficult to distinguish such ships from merchantmen until they are close up.

Speed is highly important; Jutland shows us that before, during, and after an action, maximum speed is maintained; but speed is subsidiary to hitting power.

The merchant fleet is but a part of the national navy in war time. Let it be designed, built, officered, and controlled with that fact in view. Commercial ports should be on an analogous footing.—*The Royal United Service Institute,* August, 1920.

FRENCH NAVAL REORGANIZATION.—There are signs that the Rue Royale Admiralty—which under the Leygues Ministry was living on pre-war lines just as if nothing had happened—is now awakening to the vital fact that something like a revolution has taken place in the conditions of warfare, as well as in the balance of sea power, and that neither the training nor the distribution of the fleet, nor even the utilization of the naval expenditure, are at all in keeping with the novel requirements of the French situation. In these several respects the 1921 marine budget will inaugurate a new policy and mark a move in the right direction. It will show to the world France's determination to remain a determining factor at sea and to draw full advantage from her unique geographical assets by maintaining a naval force excelling in the matter of quality if not numbers. No doubt for some time to come the republic will not be in a position to devote a very large outlay to her naval expansion, the restoration of her devastated provinces and the reconstruction of her destroyed industrial plant being certain to absorb for many years the best of her financial efforts, without mentioning the heavy expenditure likely to be entailed by the upkeep of the huge army necessary to enforce on the part of Bocheland the respect of the absurdly framed Versailles Treaty. At the same time, the strategic advantages France derives from her North Sea, Atlantic, Mediterranean, and colonial bases are such that flotillas—which could only have a defensive value for a country with the geographical situation of Bocheland, and even of Italy—would enable Old Gaul to have a say in the command of every important sea. It is this consideration which is guiding Minister Landry in his program of reforms. The rational utilization of a moderate expenditure will give wonderful results, provided the whole naval problem is considered,

and not merely the immediate Mediterranean outlook, as the tendency has been since the armistice.

Availing himself of the Parliamentary vacation, which is the only time at which a minister of marine can be said to enjoy full freedom of action and to have the possibilities of doing, unfettered, real good constructive works, M. Landry has just paid to Brest Arsenal a lengthy visit, which is likely to be all the more fruitful as he was accompanied by Chief of General Staff Salaun, our eminent Breton First Sea Lord, who has spent the greater part of his career in Brittany as flotilla commander and in recent years as Brest préfet maritime. One drawback of France's geographical situation is that it led in the past to the splitting of the fleet into two distinct forces: *L'escadre de Brest* and *L'escadre de Toulon;* and to this lack of concentration historians trace most of the naval disasters suffered by France; for this reason, the question of French naval policy and fleet distribution offers practical difficulties much greater than those English experts are called upon to solve. No wonder the service is yet divided by the controversy between the *Méditerranéens* and the *Brestois.* But the merits of the case are being altered by the shifting of the naval center from the Middle Sea to the ocean, where already, on paper, Great Britain, America, and Japan are keenly competing for the supremacy and for the obvious political and economic advantages which it confers, so that the actual situation is totally unprecedented. Another *fait nouveau* to take into account is that the cooperation of the rapidly developing submarine and aerial instruments of combat is certain, at no distant date, to drive the big surface ship from the narrow seas, and especially from the Mediterranean. No need of battleships for France to ruin Italian bases and for Italy to effectively strike at France's most vulnerable points, whilst no one acquainted with the Mediterranean exploits of the badly handicapped Boche submarines will deem it possible for a belligerent battleship to safely proceed from Gibraltar to Port Said, in the event of a general conflagration in which France, Britain, and Italy would be enemies. If the Mediterranean has become the premier center of international political and economical rivalry, its naval days are numbered; it is earmarked as the dominion of the aerial machine and of the ubiquitous submarine.

Slowly but surely the trend of political and naval developments is leading to the creation of a strong, fast, ocean-going Brittany fleet, with Brest as headquarters, and Dakar and Fort de France, and also the Aix roadstead as auxiliary bases, that will be at all times the weighty argument of French world politics. Brittany will thus remain the mainspring of Gallic sea power, in the matter both of recruiting and of shipbuilding, as both Lorient and St. Nazaire yards, where important improvements are in hand, will continue to be extensively used by the Paris Admiralty. It is understood the naval facilities afforded by the unique roadstead of Brest are to be further increased, and already the flotillas have received reinforcements in the shape of submarines with long radius of action. It is judiciously thought a purely defensive force would be sheer waste on a base strategically situated as is Brest. The command of the mouth of the Channel and of the Bay of Biscay, together with distant action in the Atlantic, will be the *raison d'être* of the Brest force, in keeping, moreover, with the time-honored tradition that ever since 1887 Admiral Aube has located cruisers at the French Land's End.

In what regards the present exigencies of the Mediterranean situation it has been thought that efficient training requires the concentration of the whole battle and auxiliary force in one *flotte de combat,* under a unique and responsible commander-in-chief enjoying the necessary freedom of action. The 1918 dividing of the fleet into the Toulon and Levant *escadres*, with a nominal chief at Constantinople, was obviously not rational, and was brought about by considerations foreign to the interests of efficiency. The Toulon-Bizerta dreadnought force, though small, is to be no longer a make-believe. Up-to-date aerial and torpedo auxiliaries and adequate means of training are to make it a ready and relatively powerful *instrument d'offen-*

sive. More important still, the *Divisions des Écoles,* now behind the times, are to be modified in conformity with the lessons of the war. Bombing, mining, and torpedoing are to receive due attention.

The performances of the *L-72* dirigible, though remarkable, have not convinced French naval men of the need of such aircraft for the Republican navy. Even for Germany, that designed them for oversea duties against England, they have turned out to be a doubtful investment. Frenchmen who have shot down half a dozen of them are naturally impressed with their extreme vulnerability and their lack of reliability in rough weather. And even when it has been found practicable to substitute for hydrogen incombustible helium these huge rigids will yet offer visible and vulnerable targets and be more or less at the mercy of the wind. But the most telling argument against them is that with the rapid development of the bombardment seaplane they are being deprived of their main *raison d'être,* which was the transportation over long distances of a good supply of heavy bombs. For the direct and indirect cost of a single *L-72* it would be possible to construct a dozen *avions de bombardement* of the largest type and highest speed, that would represent three or four times the same bombing power, together with greater handiness and reliability, while absorbing a personnel considerably smaller. The *L-72* is shortly to be tested over the Mediterranean, but at the present stage the latest 1800 h. p. and 2500 h. p. *avions de grande offensive* are believed to satisfactorily solve the problem of safe and uninterrupted communications over the Toulon-Corsica-Bizerta route. Yet it is felt it would be unwise to neglect any source of aerial power.

The Antwerp international athletic competitions have up to the present brought sore disappointment to France, and especially to Minister Landry, who, in his patriotic desire to renovate the physical standard of the *Marine Française,* had been at pains to arrange for a careful selection of naval athletes and for special training courses. France's modest performance in the international contest on the morrow of the remarkable part she played in the war would be amazing if one did not remember that the hardy French peasantry composed practically the whole of the combatant armies of Joffre and Foch, and that French peasants have not yet been touched by the sporting fever. But from this humiliating defeat good will spring in the not distant future, as Parliament will have additional reasons not to delay any longer the voting of the projected "*Loi sur l'Education physique obligatoire,*" that has been framed by military specialists with a view to further improving the quality of the French soldier and keeping alive in the Gallic heart the old fighting instinct. Outmatched numerically, the Republic must at all costs secure superior individual worth or prepare to make room for better-endowed or organized competitors.

Similarly, greater determination will mark the efforts of the Marine Minister in reorganizing on efficient lines the physical training of the fleet. From the recent comparative survey of the methods followed in other navies, the conclusion has been drawn that the American compulsory training system for naval officers is not, despite its merits, suited to the French temperament, and consequently that the intensive practice of sports *à l'Anglaise* is the course best adapted to French requirements and likely to give the most immediate results. Moreover, whereas the question of physical fitness formerly hardly exercised any influence on the career of our officers, it is henceforth to be given primary importance, especially in the case of appointments to responsible duties at sea. This will prove a far-reaching innovation, and a powerful inducement for *officiers de vaisseau* to substitute the manly practice of sports and of daily physical efforts for their former exaggerated love of *paperasserie* and of mere bookish attainments, although, in truth, the system rather than the men is responsible for the incredible time the Gallic navy is yet wasting on useless red-tape formalities.—*The Naval and Military Record,* Sept. 1, 1920.

GREAT BRITAIN

ADMIRALTY POLICY.—Amid the many problems which confront the empire at the present time, that which concerns its naval defence cannot be allowed to drift altogether out of the minds of the people. It is a very natural thing that after a great war public interest should react from most of the questions connected with the fighting services, and should concern itself almost exclusively with matters which ostensibly belong to peace and not war. But it is, as readers of this journal will well understand, a mistaken attitude to suppose that peace can be preserved so easily. In our own case, it will be preserved so long as we look to our means of defence and keep them adequate and efficient, and chief among those means of protection is the fleet, for, as Lord Beatty has said several times lately, we came into being by the sea, we exist by the sea, and the day that we forget it, and forget sea power and all that it means, the British Empire will begin to crumble to the ground.

It is a matter for satisfaction that as regards the immediate future the Admiralty has made a frank revelation of its aims, and all who have studied the statement of policy issued by the First Lord in March will have gathered that there are three main principles upon which the Board are proceeding. They have first of all laid down a standard of strength for the navy in commission and in reserve which is the irreducible minimum compatible with the safety of the empire. This standard provides no more than is absolutely necessary for the peace duties of the navy on the one hand, for the training of officers and men for war service, in case of need, on the other hand. Indeed, there are those who probably consider that it provides less than is necessary, for during the present year the main force of the navy, the Atlantic fleet, has had such a number of calls upon it as must have reduced the opportunities for sea training considerably. With squadrons detached to places as far removed as Constantinople and Copenhagen, there must have been little or no opportunity for the study and practice of gunnery and other tactics and problems. This is a matter which should be rectified before long.

The second principle upon which the Admiralty are working is to lay down the lines along which the training of officers and men must proceed. It is a good sign that so many pages of the official statement should have been occupied by personnel questions, and that in addition to the advancement of technical training, staff courses and the like, and of university training for junior officers, the Board are also keeping in touch with the progress of social conditions. They have a good record of work for the advancement of the welfare of officers and men, and for what remains to be pursued in this direction it is manifest from Lord Beatty's speeches that he is keen and anxious to improve the lot of those now serving. His exhortations, although addressed to the public, ought not to be lost upon the higher authorities in the government as an indication of what they, from the professional point of view, are expected to supply. The pity is that ministers are so often heedless of their expert advisers in such matters, although, as Lord Jellicoe has recently said, it would seem a matter of common sense that those who have not adopted the navy as a profession should pay as much respect to the professional judgment of the naval officer as they would to that of the surgeon, or the engineer or the lawyer, each in his own sphere.

A third strong point in the Admiralty's policy concerns the necessity for further scientific research. On this subject the lesson of the war is plain. We must never again be caught at a loss in regard to types of ships, weapons or appliances which are necessary to the work of the navy, but the development of which has been neglected.—*The Army and Navy Gazette*, Sept. 18, 1920.

NOTE.—For full statement of British Admiralty policy, refer to Professional Notes in August issue.

FUTURE NAVAL CONSTRUCTION.—At a moment when the best brains in all navies are being employed to consider the future composition of war fleets

it is well to have the views of so important a writer as Professor William Hovgaard on warship design. He is a recognized authority on this subject, and what he has to say will be read with interest not only because of his many years' study, but also in view of the position he holds of Professor of Naval Design and Construction in the Massachusetts Institute of Technology. Based on lectures prepared for the naval construction course there, he has published a new volume on the modern history of warships, in which, after tracing the curve of evolution for each class of vessel and for each of the important elements of design up to the present time, he takes a survey of the position to-day and seeks to determine the direction which that curve must follow in the nearest future up to the point where new factors, technical or military, make their appearance and influence the development. His remarks are the more interesting when read in conjunction with those of Lord Beatty, Sir Eustace d'Eyncourt, and other authorities in this country who have referred to the problem of the future warship.

As to the battleship, Professor Hovgaard refers to the paramount importance of what he calls the "speed armament gauge," and anticipates that the speed will advance beyond the 21 or 22 knots now common, and that the caliber of the heavy guns will be increased beyond the hitherto usual limit of 14-inch or 15-inch, the United States having already, in fact, adopted 16-inch weapons. There appears to him no immediate necessity for augmenting the thickness of vertical armor, but the horizontal armor may be further developed in view of the great angles of the fall of projectiles at extreme fighting ranges and the dangers of aerial attack, while a more efficient under-water protection is imperatively demanded. Thus he expects to see a further advance in the size of battleships, but to avoid, as far as possible, the effects of the limits imposed by restrictions in the use of ports, docks, channels and canals, it seems to him wise not to exceed the displacement necessary to secure the desired nautical and military qualities. As regards battle cruisers, it is interesting to recall that in 1905, in a paper read before the American Society of Naval Architects, he advanced the idea of a "battleship cruiser," explaining the causes which he believed would necessarily lead to it, and in the *Hood* he considers that the evolution of the battle cruiser has finally reached the ideal type he thus describes. Yet he points out that if battleships and battle cruisers are merged into one type this will simply result in the creation of a new super-battleship; after a time the latter will become the standard, and the need will be again felt for a further type which in a more eminent degree possesses the element of speed.

Present practice in America and Japan, so far as it is revealed, supports Professor Hovgaard's theory, for both nations are building battleships and battle cruiseers at the same time. As to what Great Britain will do it is idle to speculate. Rear Admiral Chatfield, whose special duty as Assistant Chief of the Naval Staff is concerned with the development and use of material, including types of vessels, admitted in the spring that if the Admiralty were to build a new capital ship they would not reproduce the *Hood,* but he wisely refrained from indicating in what direction the opinion of those responsible is moving. On the other hand, Sir Eustace d'Eyncourt, than whom there could be no higher authority, has given the assurance that the *Hood* is "as safe against attack from torpedoes under water as she is against gun attack above water." Here we touch upon an important question which is likely to be of increasing importance in the near future, in view of the enormous cost of new construction as compared with that before the war.—*The Army and Navy Gazette,* Sept. 4, 1920.

NEW SIGNAL DEPARTMENT.—On April 17 it was ordered that the duties connected with signals hitherto performed at the Admiralty and by the Superintendent of Signal Schools, Portsmouth, under Admiralty directions, were to be combined and dealt with by a single department at the Admiralty known as the "Signal Department." All matters connected with the provision, organization, and maintenance of, and the training of personnel in

wireless telegraphy, radio-telephony, visual signalling, etc., will be within the scope of the department, at the head of which is the Director of the Signal Department (short title, D. S. D.). This officer is on the same footing as the Director of Naval Ordnance and the Director of Torpedoes and Mining. Captain John K. im Thurn was appointed the first Director of Signals on April 28.—*The Royal United Service Institute,* Aug., 1920.

ITALY

ITALIAN FLOTILLA LEADERS.—Mainly in consequence of the financial situation, but partly owing to experience gained during the war, the Italian Government proposes to revise its naval policy, and in future to build and maintain only relatively small vessels, such as scouts, destroyers, and submarines. Pursuant to this decision the majority of the armored ships are to be paid off and the battleship *Caracciolo* is to be completed as an oil fuel depot. So far as is known, the only war vessels now under construction are eight or more flotilla leaders of an unusually powerful type, which, displacing as they do from 1900 to 2200 tons, are more akin to small cruisers than torpedo craft proper. Irrespective of these new vessels, the Italian Navy already includes a number of destroyers or flotilla leaders, which are perhaps the most powerful representatives of their type afloat. Although of slightly smaller tonnage than our flotilla leaders of the *Scott* class, the four Italian units of the *Aquila* class, originally designed for Roumania, have a more formidable armament and virtually the same speed. The *Aquila, Nibbio,* and *Sparviero* each mount three 6-inch and four 14-pounder guns, and the *Falco* has six 4.7-inch, as compared with a standard armament of five 4.7-inch in the British *Scott* class. In the new Italian leaders, designated as the *Leone* and improved *Aquila* classes, a uniform battery of eight 4.7-inch is to be mounted, together with six torpedo tubes. Through the courtesy of Messrs. Gio. Ansaldo and Co., of Genoa, a firm whose long and honorable association with Italian naval development is well known, we are able to give below a detailed description of two separate groups of flotilla leaders, recently constructed by them, which embody to a marked degree the essential characteristics of modern Italian torpedo craft. The first group comprises the *Carlo Mirabello, Auguste Riboty,* and *Carlo Alberto Racchia,* launched respectively in 1914, 1915, and 1916; the second consists of the *Alessandro Poerio, Cesare Rossarol,* and *Guglielmo Pepe,* launched in 1914-15. All six vessels were completed in time to take part in the operations of the war. As their official classification—*Esploratori*—indicates, they were designed to act as scouts as well as torpedo vessels, and to this end were given dimensions and sea-going qualities superior to the average run of destroyer, while special regard was also paid to strength of construction. They proved, without exception, to be fast, weatherly vessels, able to keep the sea in nearly any weather likely to be encountered in the Adriatic and the Mediterranean. Their good speed and powerful armament made them more than a match for the largest Austrian destroyers and equally a terror to enemy submarines. Thanks to careful design and skilled workmanship, the propelling machinery developed on trial a power some 20 per cent in excess of contract requirements. The completion of the three *Mirabellos,* which had been ordered at the end of 1914, was somewhat delayed in consequence of labor and material shortage, but these and other difficulties incident to war-time construction were not permitted to prejudice the quality of the work.

We shall deal first with the *Mirabello* class, the principal dimensions of which are as follows:

Length between perpendiculars	340 feet
Breadth moulded	32 feet
Draught over keel	9.8 feet
Normal displacement	1570 tons
Ratio of breadth to length	10.395
Block coefficient	0.517 (metric)

Structure of the Hull.—A vertical central keelson runs the entire length at the same height as the double bottom in the engine-room and as the boiler-room floors. The frames are of the usual type, consisting of floor, principal, and reverse angles, channel-shaped at the sides; they are spaced 21.6 inches apart and are joggled to save the weight of strips between them and the outer strakes of the shell plating. In the engine-room special reinforced frames are fitted where possible. The cellular double bottom, of 31½ inches height under the propelling machinery, is arranged for carrying oil fuel. The deck extends from the forward to the after perpendicular; the beams are cut in way of wing cofferdams and are continuous from side to side where no longitudinal water-tight bulkheads are fitted. The forecastle deck is carried aft as far as the forward funnel. Below this deck there is a partial flat forming a 'tween deck of nearly 7 feet 6 inches. Specially strong beams are fitted both under the main and forecastle deck plating at intervals between the ordinary deck beams. Longitudinal lateral girders run beneath the deck fore and aft, and a girder is worked in at each side between the main and forecastle decks.

Internal Compartments and Oil Fuel Service.—The system of main water-tight transverse subdivision is indicated on the drawings on the next page. The oil fuel compartments, having a total capacity of 8200 cubic feet, are subdivided into 18 separate water-tight tanks, of which the ceiling, where not formed by the double bottom inner plating itself, is in all cases at a level below the normal water line of the ship. The tanks can be filled from the exterior at four different stations, two of which are situated in the forward part and two amidships. Oil can also be taken in by means of two steam pumps carried on board; these pumps, of the Simplex type, have a capacity of 32 tons per pour and are housed in separate compartments. They are equipped with piping and valves to permit the transfer, in case of emergency, of fuel from one compartment to another Four pumps with a capacity of 12 tons per hour convey the oil through heaters and filters to the burners. The oil fuel piping consists of a ring collector with an independent branch to every compartment.

Bilge and Fire Service.—For bilge and fire service there is a main suction pipe of 3 inches clear diameter, with several branches to the bilges, and eight 40-ton steam ejectors. The fire main, of 2.36 inches clear diameter is fitted below the deck beams. Pipe ends have standard threads and couplings for use with canvas hose. The pumping plant comprises the following:—Two duplex steam pumps, capacity 15 tons per hour, one in each engine-room; one turbo-electric pump, 30 tons per hour, in engine-room aft: one Challenge type portable pump of 5 tons capacity; one Downton pump fitted on deck.

Fresh Water Supply.—Certain of the lateral cofferdams are used for reserve feed water, the total capacity being 33 tons. Drinking water is carried in two independent galvanized tanks with total capacity of 3 tons. The fore peak tank and a second compartment below the flat are utilized for storing water for washing purposes. These tanks can be filled from the exterior and also by means of the Excelsior quadruple pumps used for filling the gravitation and distributing tanks.

Sanitary Arrangements.—Connections are taken from the fire main to distribute salt water to baths, wash places, and water-closets for officers, warrant officers, and crew. The officers' water-closets are also fitted with small Excelsior pumps for direct service from the sea. Effective sanitation is secured by a small turbo-electric pump of 10 tons capacity hourly, with direct suction from the sea and delivery to the main fire collector pipe.

Ventilation.—Large exhaust fans are fitted in the wardroom, petty officers' mess, and dynamo-room, and ventilators in the men's quarters forward.

Steering Gear.—Powerful hand and steam steering gears are provided, both working on the double-screw system. The steam steering gear situated in the after engine-room consists of a vertical two-cylinder engine capable of being safely driven at full boiler pressure. Seventy revolutions

suffice for putting the rudder from the center to hard over. The hand steering gear has two wheels of the usual large diameter. A suitable arrangement of couplings and pins enables the change over from steam to hand gear to be effected instantaneously. Should the double screw gear be put out of action through damage, resort may be had to an auxiliary mechanical gear, consisting of a toothed sector normally loose on the rudder shaft, which can easily be fixed with strong pins after the cranks of the damaged gear have been dismounted. Furthermore, a reserve bar is provided for working the rudder by hand with tackles.

Anchors, Chains, and Capstans.—The bower anchors are each of 40 cwt. stockless type, with a shank of forged iron and steel flukes cast in one piece. Nine lengths of cable, each 82 feet long, are provided. Adjacent to the bow there are two electric capstans, each operated independently and having a rotary converter of the closed and ventilated type, which in normal service requires nearly 295 ampères and 105 volts, feeding a motor of 27 horsepower. Transmission is effected by a helicoidal gear, which can be rigidly connected with the capstan by means of skin friction discs. A switchboard for control is fitted under the forecastle. It is possible to weigh the anchors at a rate of 39 feet per second, the normal tension exerted being more than 5½ tons, although for a few moments a maximum pull of nearly 12 tons can be attained. A third electric capstan of smaller type is mounted aft for mooring purposes and for serving the derrick.

Four boats are provided, including a 26-foot petrol launch with a speed of 12 knots.

The masts are built principally of steel, the main mast being reduced in height and of specially stiff construction to obviate the use of shrouds, which interfere with the training of the guns.

All living spaces throughout the ship are sheathed with wooden planking, the decks being covered with linoleum. The washing places have running water with overboard discharge. The ship is heated and lighted by electricity.

The front and sides of the bridge, which is built at a height of 4 feet 8 inches above the forecastle deck, are enclosed by a framing of brass and wood with sliding windows. Below and abaft the bridge are situated a small cabin for the commanding officer, the charthouse and the wireless telegraphy room.

Magazines.—The magazines, two in number, are entirely sheathed with insulating material, viz., cork slabs 2 inches thick, with a covering of reinforced "litosilo." Racks are provided for the 4 inch cartridges and the after magazine contains boxes for storing torpedo war heads and depth charges. Both magazines are equipped with an electric fire alarm system and with Kingston flooding valves, which can be operated from the deck. The 4-inch guns are served by a special electric hoist controlled from the deck, which can deliver 18 rounds per minute. The 6-inch bowchaser is supplied by a cage hoist with an electric winch. All these hoists are of the Ansaldo patent system and are furnished with emergency hand gear.

Refrigerating Plant.—The refrigerating plant consists of two independent sets, each of 5000 calories per hour. Refrigeration is performed on the direct carbonic acid expansion system. The compressors are operated by belt transmission Irom electric motors of 5 horsepower. An air cooling system is fitted to each magazine.

Armament.—The armament comprises one 6-inch 40-caliber gun—45 calibers in *Mirabello* only—seven 4-inch 35-caliber guns, two 2-pounder anti-aircraft guns, four 18-inch torpedo tubes on twin mountings. The torpedo tubes are constructed of steel, the torpedoes being fired by a charge of powder. The compressed air system for the torpedoes is tested to 400 atmospheres, and a branch leads to the boiler fronts for tube cleaning purposes. The after deck is fitted for the carrying of 100 mines, with a tramway for minelaying, racks for depth charges, and davit gear for explosive paravane sweeps.

Electrical Equipment.—Continuous current at 110 volts is used. The generating plant includes two 30-kilowatt turbo-dynamos and one 15-kilowatt Diesel dynamo. There are seven independent wirings from the main switchboard, viz., one lighting circuit for engine-rooms, boiler-room, magazines, and gun positions; one lighting circuit for living quarters, pantries, etc., with commutators for changing over from the normal white light to blue light in action; one circuit for the wireless telegraphy, one for signals, one for auxiliary engines and heating apparatus, and two circuits for the searchlights. Six small independent accumulator batteries are supplied for emergency lighting in the machinery spaces and magazines.

Propelling Machinery.—The propelling engines consist of two sets of simple geared turbines situated in two separate water-tight compartments, each set being complete in itself and capable of being operated independently. Each set comprises one high-pressure and one low-pressure ahead turbine. Astern turbines are cased in with the low-pressure ahead turbines. Adjusting blocks of the pivoted oil film type are fitted at the forward end of the turbines, which transmit their power to the gearing through flexible couplings of the claw and sleeve type. In the low-pressure ahead turbines provision is made for admitting steam exhausted from the auxiliaries. Steam is generated by four water-tube boilers housed in four separate water-tight compartments. The total heating surface is 40,000 square feet.

The machinery has developed an aggregate of nearly 46,000 shaft horsepower, and on trial a maximum speed of 36.8 knots was attained, while the contract speed was 35 knots. The power developed when going astern is almost half the figure reached when steaming ahead.

The turbine cylinders are of hard, close-grained cast iron, smoothly bored inside and divided horizontally into two parts. The rotating parts of the turbines, consisting of the rotor shaft and wheels, are made from ingot steel forgings, while the blading is of drawn bronze bar. The bearing bushes for the rotor shaft are made of gun-metal lined with white metal. The whole of the bearings and adjusting blocks are arranged to work under a system of forced lubrication, with oil baffles at the ends of the bearings.

The gearing is of the double helical type suitably dimensioned to give the necessary ratio between the turbine and propeller revolutions. The rims and shaft of the main gear wheels are made from ingot carbon steel forgings, while the bosses of the wheels are of cast steel. The pinions, which are forged solid with their shafts, are of nickel steel. The gear cases are made in upper and lower sections, the first built up of steel plates and angle bars, the lower section of cast iron. To obtain efficient lubrication oil sprays are fitted to the gear cases in such positions as to spray oil upon the engaging teeth of pinions and wheels when moving either ahead or astern.

Lubrication is effected by oil pumps mounted in pairs in the two engine-rooms. In connection with the forced lubrication system each engine-room contains the necessary oil drain tank, oil reserve tank, oil cooler, and suitable piping and mountings.

The shafts are of hollow forged steel, the tail shafts being of nickel steel. The screw propellers are built of manganese bronze and are secured to the shafts by means of a key and nut. The thrust of each propeller is taken on a pivoted thrust block supplied with forced lubrication on the same system as that applied to the turbine adjusting blocks.

The condensers are of the heart-shaped pattern now generally adopted, each having a cooling surface of 9420 square feet. They are constructed with a steel plate shell, rolled Muntz metal tube plates, and solid-drawn brass tubes. The low-pressure turbines are connected with the condensers by means of large exhaust bends built up of steel plate and angle bars.

Feed water is supplied by two Ansaldo type evaporators, each delivering 4400 gallons of fresh water per 24 hours, and combined with a distiller condenser delivering 1750 gallons of water in the same period.

The main steam piping is so arranged that steam may be conveyed to each set of turbines from any of the four boilers. The tubes are of welded steel plates with forged steel flanges. Any boiler may be cut out of service by intercepting valves. The auxiliary engine steam piping is independent of that of the main steam supply, but in each engine-room a special connection with suitable valves is provided between the main and auxiliary steam piping. The exhaust steam pipes are arranged to lead exhaust steam to the turbines, condensers, or atmosphere as it is needed. There are two independent feed pipe systems, one main and one auxiliary, each complete for supplying all the boilers. The main pipe conveys the water to each boiler through a surface heater and an automatic feed regulator connected with two relief valves, fitted on the water pockets of the boiler. The auxiliary pipe supplies water direct to the boilers through the handworked feed valves. Air pumps deliver the water into the tanks, from which it is drawn by the feed pumps. These are eight in number, placed in pairs in each boiler-room, each pair comprising two single pumps The feed pumps are able also to draw the fresh water direct from the reserve tanks through suitable piping.

As stated above, the four water-tube boilers are housed in separate compartments. The heating surface of each boiler is 10,225 square feet, the total heating surface of the four boilers being 40,900 square feet. The working pressure is 250 pounds to the square inch. Oil fuel is used exclusively on the closed stokehold system of forced draft. There are single and multiple sprays, with their respective air cones, of the usual type. Oil is supplied to the burners by four pumps, one for each boiler-room, which pass the fuel successively through the cold filters, heaters, and hot filters to the distributing valves attached to the boiler fronts. Air for combustion is supplied by turbine-driven steam fans, two for each boiler, each having a capacity of about 32,000 cubic feet per minute.

Stability and Rolling.—Stability trials carried out when the vessel was nearly completed, on a normal load displacement of 1530 tons and with a mean draft of 9 feet 2 inches, gave an effective metacentric height of 30 inches—0.762 m. In order to reduce the rolling a system of anti-rolling tanks and gyroscopic stabilizers had been installed, but the behavior of the vessels at sea proved to be so satisfactory that this system could be dispensed with, and the spaces provided for anti-rolling tanks have consequently been utilized for the storage of oil fuel. The following table gives the distribution of weights:

	Tons
Hull and structural parts	512.4
Deck sheathing	9.5
Complementary steel structures	18.2
Cement and paintwork	8.4
Pumps and piping	18.0
Fans and ventilators	6.2
Steering gear	12.8
Capstans, bitts, bollards, etc	14.2
Distillers, lavatories, baths, etc	9.0
Officers' and petty officers' furniture	12.0
Mess deck fittings and shelves in stores	13.0
Masts and rigging	2.6
Anchors, chains, and cables	19.0
Boats	4.0
Voice pipes and accessory equipment	2.5
Equipment stores	20.0
Awnings, canvas covers, and sails	1.2
Wireless telegraphy equipment	2.7
Electric plant, including dynamos	28.9
Armament	53.3
Ammunition	22.0
Store-room fittings	10.4

	Tons
Magazine equipment	16.8
Torpedo tubes and accessories	12.9
Torpedoes and war heads	4.4
Main engines, complete	239.6
Propellers, shafts, and bearings	52.2
Boilers, uptakes, and funnels	305.2
Spare parts, ladders, etc	27.4
Water in boilers and condensers	62.3
Consumable stores	6.0
Complement and appurtenances	15.0
Drinking water	3.0
Washing water (normal)	10.0
Washing water (extra)	10.0
Reserve feed water	32.9
Oil fuel in filter tanks	47.9
Oil fuel in compartments (normal)	213.6
Oil fuel in compartments (extra)	112.5
Total (full load displacement)	1972.0

The three vessels of the *Alessandro Poerio* class, comprising the name ship, the *Cesare Rossarol*, and *Guglielmo Pepe*, are somewhat smaller than the *Mirabellos*. Their principal dimensions are:

Length between perpendiculars	278.88 feet
Breadth moulded	26.25 feet
Draft	8.60 feet
Normal displacement	930 tons
Ratio of length to breadth	10.5
Block coefficient	0.505 (metric)

In these vessels, as in the preceding class, high-tensile steel has been largely employed, especially for the shell and deck plating. Details of the vessels are shown in the engravings on pages 268 and 278. The oil fuel compartments are furnished with pipes of a number and diameter sufficient to permit the filling of all tanks in a space of two hours. The pumping system for bilge, fire, and fresh water service and the sanitary arrangements are, generally speaking, very similar to those in the *Mirabello* class, of which these vessels are smaller editions.

The armament consists of two 4.7-inch 40-caliber guns mounted respectively on the forecastle and quarter deck; four 3-inch 40-caliber guns on the broadside; and four 18-inch torpedo tubes on two twin-deck mountings. Each of the two magazines contains 260 rounds for the 4.7-inch guns and 560 rounds for the 3-inch. The hoists are worked by hand. Eight torpedoes are carried, four of which are in the tubes and four in reserve. The electric plant is operated by two 30-kilowatt generators with turbo-motors. The propelling machinery resembles in all essential features that of the *Mirabello* class. The maximum power developed on the trial runs was 25,200 shaft horsepower, equivalent to a speed of 33.4 knots. Although of comparatively moderate dimensions, these vessels have an extensive cruising radius, viz., 750 miles at full speed and 3000 miles at a speed of 15 knots.—*The Engineer*, Sept. 17, 1920.

JAPAN

INDUSTRIAL PROSPECTS IN JAPAN.—Of all the belligerent nations Japan was that on which the world war fell lightest. Her military operations were almost confined to the taking of Tsingtau, and her further participation in the contest consisted in the main in supplying her Allies with munitions of various kinds. This transaction quite naturally and justifiably resulted in large profits, and at the same time, Western competition being eliminated in the markets of the East, Japan entered the vacant field. The result has been that Japan, like America, has changed her financial status during the war, and from a debtor nation has become a creditor one.

The development of Japanese industries during the war forms the theme of a report[1] by Mr. Hugh Horne, Commercial Secretary to our Embassy at Tokio.

The report expresses the fear that as regards the trade in beer, cheap cotton hosiery, glassware, brushes and matches, we shall have a difficulty in recovering the ground inevitably lost during the war. In other departments of trade, however, the Japanese merchant and manufacturer has, in many cases, pursued a singularly short-sighted policy, and has ruined his prospects by supplying goods of very inferior character. As a consequence, the armistice was followed by a wholesale cancelling of orders provisionally given. The firms in question, moreover, adopted the practice of distributing the whole of the profits made as dividends in place of seizing the opportunity of building up reserves for the extension and improvement of their equipment, and for "carrying on" during possible periods of depression.

The poor quality of much of the exported goods is the more noteworthy in that as regards many commodities inspection prior to export is compulsory. This inspection is made by officials appointed by the manufacturers' guilds, but conducting their inspection in accordance with governmental regulations. The standard set is, however, very low; so that whilst it is impossible to export absolutely worthless material, the inspection provides no bar against the despatch of goods of very poor quality. As a consequence, the more far-sighted firms do not rely on these official inspectors, but have also inspectors of their own.

Japan is a country which is singularly deficient in raw materials. According to a certain school of economics Japan should accordingly abandon any ambition to become a manufacturing country, but the industrial history of Switzerland shows that the economists who rely on *a priori* reasoning are exceedingly apt to have their conclusions falsified by the facts. Switzerland in the matter of raw materials is worse off than Japan, but this did not prevent the Swiss from establishing highly successful industries, and conducting a large export trade in these, notwithstanding her lack of a seaboard. Japan is, accordingly, much more favorably situated. Minerals occur in great variety, and she can herself supply some of her requirements for those in common demand. The amount accessible is, however, relatively small. Her total reserves of coal are placed at less than 4000 million tons, of which 800 million tons lie at a less depth than 2000 feet below bank. On the other hand, like Switzerland, there is plenty of "white coal" available, and already over one million horsepower are being generated at hydro-electric stations, and official estimates show that another 7,000,000 horsepower can be economically developed. Hence Japan's aspirations towards the building up of a large trade in manufactured goods will not be handicapped by lack of power. The success of Switzerland has been largely due to the skill of her workmen, who have had an historical reputation for the execution of delicate and accurate work. Japanese workmen have had a corresponding reputation for artistic work, and there is no reason to believe that this deftness may not prove equally valuable when devoted to engineering ends. At present the Japanese workman is said to be relatively inefficient. He prefers to work leisurely and has no objection to long hours.

The pre-war rate of pay for dock coolies was 16d. to 18d. per day. It is now over 6s. per day. Carpenters who received about 2s. a day before the war now get 5s. 3d. a day, and tramwaymen have had their pay raised from about 40s. a month to 120s. a month.

Were the Japanese workman efficient these low rates would make competition with him impossible, but his relative efficiency as compared with British workmen is said not to be more than one-half to one-third. As elsewhere, cheap labor and high labor costs are frequently associated, for one reason because, when labor is cheap there is little inducement to install

[1] Report on the Commercial, Industrial and Financial Situation of Japan, 1914-1919. His Majesty's Stationery Office.

efficient machinery. Such machines are expensive, and the capital charges involved run on during slack times whilst labor costs can be reduced by dismissing hands.

Labor in Japan suffered much from high prices during the war. The government was slow in regulating prices and in equalizing distribution, and in the meantime stocks were cornered by speculators, who only released their hold under governmental compulsion. The rise in the cost of living, in spite of the apparently very favorable situation in Japan, has increased in greater proportion than in this country. In 1919 official estimates show that in Japan the increase was 256.1 per cent as against 229.4 per cent here. The facts brought forward in this respect constitute additional evidence that, on the whole, Britain mastered the difficult problem of carrying on during the war better than most of her Allies, although out of consideration for Ireland, the authorities did not carry out the distribution of foodstuffs quite equitably.

As here, so in Japan, the principal sufferers from the increase in costs have been the professional and official classes, and it is perhaps worthy of note that the unskilled dock coolie is now being paid more in Japan than is the skilled carpenter, a condition which recalls recent happenings at home, and which, in the nature of things, can hardly be permanent.

The increase in trade put a heavy strain on the Japanese railroads, of which the mileage is now 9503. In 1913-14 the number of passengers carried was 167,773,143, and in 1918-19 this had risen to 288,061,584, in spite of heavy increases in fares. The normal third-class fare was about 0.40 d. per mile before the war. It is now about 0.61d. The tonnage handled was 36,348,362 tons in 1913-14, and 53,313,720 tons in 1918-19. The development during the war years is as much as was expected during nearly thirty years of normal development. The plans for railway construction have accordingly been revised, and it is now proposed to spend on the work about 140,000,000l. This expenditure will be spread over a term of seven years. There has been a shortage of coal, the price of bunker coal, for example, having risen from the 9s. to 11s. per ton prevalent before the war to about 53s. a ton in 1919. As a consequence, the electrification of certain existing railway lines is under serious consideration. A private company is about to construct underground lines in Tokio.

With its exceptionally long coast-line, much Japanese transport is naturally conducted by water, tonnage amounting to about 806,000 tons being employed in the coastal trade alone. Freights in this service have increased enormously. In pre-war days the Mioji-Yokohama charge was 3s. a ton. This rose to 23s. a ton in 1915, and is now 10s. a ton. The ocean-going freight to Europe reached its maximum in 1917, when it was 455s. a ton. In 1919 it was 180s. a ton. Road transport, on the other hand, is little developed owing to the indifferent state of the roads. Nevertheless, some 6000 motor cars are in service, and there is a demand for 1-ton to 3-ton motor lorries. Important road improvements are foreshadowed in the early future.

The Japanese are anxious to establish dye and chemical industries, and Mr. Horne expresses surprise that the dye manufacturers are to be protected at the expense of the textile manufacturers, since the dye industry is in a very backward stage of development. No doubt this is the very reason for the desire to encourage its development. In part, no doubt, to ensure Japan the possession of plant capable of diversion to the production of explosives and gas shells in case of war, but also in the belief for which history provides ample warrant that present sacrifices may often result in future gains. Our own mercantile marine was built up largely on the Navigation Acts, and it is appalling to think of what the present price of steel would be had its manufacture in America not been encouraged by the sacrifices of a past generation.—*Engineering*, Sept. 10, 1920.

DANGERS OF JAPANESE-AMERICAN FRICTION.—If permitted to go on the sort of irritation and pin-pricking that has been indulged in by both the

Japanese and by the Americans "may lead to almost anything," is the warning issued by Mr. Hanihara, Japanese Vice-Minister of Foreign Affairs, in an official statement issued at Tokyo. Mr. Hanihara can see no possible cause for a crash between his country and the United States, yet the condition of irritation is so frequently eruptive that he declares "we must go straightway to the root of every anti-Japanese and anti-American agitation or movement with the acts of ruthless publicity and education," and he adds: "Light must be thrown upon dark places; no sore must be allowed to fester unseen. If both parties are determined on a square deal we may look forward with absolute confidence to lasting peace and friendship on the Pacific." The possibilities of cordial relationship and harmonious cooperation between Japan and the United States, he maintains are "so tremendously great and the interests at stake so vast and far-reaching that we cannot afford to trifle or muddle with any question, however trivial in itself, that is of common concern to us." Press reports quote the Vice-Minister as saying further:

"Many far-sighted men have predicted that the Pacific Ocean would become the chief theater of world-events, and this prophecy seems now in a fair way to be realized. Never before have the relations between the United States and Japan, two of the principal countries bordering on that ocean, attained their present degree of importance. It is hight time, to my mind, for people on both sides of the Pacific to awaken to the significance of the new era that has dawned and ponder with deadly earnestness things that concern them jointly.

"Both here and in America there certainly have been men, broad-minded and forward-looking men, who, with almost religious ardor, have advocated the good relationship of the two nations. I am second to none in doing homage to these zealous workers for the noble cause they have espoused.

"It appears to me, however, that it is not enough for a handful of representative Japanese and Americans to talk of good-will and mutual friendship around dinner-tables and in formal messages. What is above all needed right now is right feeling, sympathetic understanding, and generous treatment of one another on the part of the two peoples as a whole. It is this charitable attitude of the popular mind that every true friend of Japanese-American amity should endeavor to cultivate. . . .

"The Japanese question in California, for instance, has done more than anything else to ripple the otherwise smooth surface of our interrelationship. But no vital interest of either country is necessarily involved in this question. It is only a local affair, as so many of the American friends of Japan are accustomed to call it by way of dismissing it. Why should it then be suffered to remain a standing source of mischief and misunderstanding?

"If right feeling and proper understanding prevailed on each side and the momentum of healthy public opinion were brought to bear on it, the entire question would be solved without more ado. The lack of knowledge and appreciation of each other and an inability to think the other fellow's mind are what lie at the root of all that goes to disturb our peaceful intercourse."

But the sorest spot in the American-Japanese relationship, according to many Japanese journals, is the anti-Japanese agitation in California, and as an example of the bitter comment to be found we may take the utterance of Mr. Katsuji Inahara in the Tokyo *Yamato*. He holds that the Japanese in America "are being subjected to the treatment which led to the exclusion of the Chinese," and he proceeds:

"The reason why the Japanese immigrants were welcomed at first was that extra labor was needed to open up virgin soil, but now that the task is over, the Japanese are no longer wanted. This is responsible for the present anti-Japanese agitation. The Japanese are threatened with absolute exclusion. China submits to exclusion by treaty, while Japan refrains from sending any more emigrants under the gentlemen's agreement. Both are the same thing in effect. The agitators have now set about throttling

our brethren in California. We should not be complacent and say that the agitation is merely an offshoot of the political season.

"Some say that the exclusion of the Japanese is due to economic reasons, but these people are only imitating the sayings of Americans. How can the control of only 30,000 acres by the Japanese out of a total of 100,000,000 acres in California be the reason for the vehement agitation? Reference is made to the lowness of wages and of the standard of living, but these are not important matters. It is further pointed out that the Japanese have a different civilization and are difficult of assimilation. Again, these are not the real reasons for their exclusion. The real reason is to be sought elsewhere.

"It is to be found in a manifestation of *yaju-sei* (wildbeast nature). To speak plainly, it is of a piece with the instinct of a dog which barks if the passer-by has alien appearances. It is an inhuman and bestial instinct and does not, of course, bear the slightest resemblance to the spirit of the League of Nations. At Versailles, Mr. Wilson confirmed the bestial instinct as strongly as possible. At that very moment he was not a human being, but a beast."

The Tokyo *Yorodzu* describes the anti-Japanese movements in America as "fanatical" and laughs at the idea that they are designed to meet the purposes of the Presidential election. The fact is that "the Americans are now trying to subject the whole world to their selfish plan, and this action is more harmful to the cause of humanity than was German militarism." America is "no longer a country of Lincoln, but a land of selfish devils," and the *Yorodzu* continues:

"There are not a few among our countrymen who are subsisting on incomes from the American sources. They are liable to be spellbound by the American propaganda. We do not know what opinion they entertain about the recent American activities. But the Japanese people may have now realized what the ultimate objective point of the American drive is. The Japanese people are always friendly to foreign nations and are anxious to preserve peace. But they will not stand for anything which will tend to destroy international relations. The Americans may maintain that they are only attacking the militarism of Japan in the interest of peace. But eloquent facts have now exposed America's true intention. Do not the American people care even if their actions should cause serious results?"

In contrast to the horror inspired by America among newspapers like the one just quoted, we find a gentle note of tolerance in the Tokyo *Chuwo*. which ascribes anti-Japanese movements in America to the election-fever period, and observes:

"Japan does not permit laborers to go over to America. The Japanese in America do not interest themselves in politics nor in revolutionary movements; they conscientiously observe the American law and earnestly pursue their daily occupations. Such people should be valuable to the Americans, who ought to welcome them. The so-called anti-Japanese agitation in America is a question affecting America's sense of justice and humanity.

"The Americans, however, have special peculiarities. They say malignant things, but they are not so malignant at heart. They enact a law, but they are not necessarily determined to carry it into effect. But everything in elections is decided by the number of votes, and in order to obtain as many votes as possible the candidates and their supporters do not hesitate to take any steps. The so-called anti-Japanese movements are only designed to win the votes of farmers and laborers.

"In these days some influential Americans are urging the necessity of cooperation between Japan and America, and there are indications that Japanophobia is about to give way to Japanophilitis. The opportunity should be taken by the Japanese authorities and people further to promote their friendship with the Americans."

The Tokyo *Chugai Shogyo* is earnest in its expression that Japanese-American friendship "does much in the interest of the world-peace and is especially conducive to the tranquillity of the Pacific." If there should be

war between Japan and America it would involve the whole world, remarks this journal with a solemn sense of appreciation, yet it feels that most Americans belong to the intelligent class and are "alive to the need of Japanese-American friendship and are trying to promote it with the object of preserving the peace of the Pacific and of furthering the civilization of the world." Unfortunately, this journal goes on to say:

"Low-class laborers and unintelligent men of America, however, are jealous of Japan, who has won her place among the powers of the world, and of her laborers, who are industrious and faithful. Jealously, fear, and suspicion have led to anti-Japanese movements, and the statesmen and journalists who are only concerned with their own interests are catering to the laborers and unintelligent persons.

"It is difficult for Japan to connive at the present anti-Japanese situation in America. Are not repression of the negroes and the exclusion of the Japanese contrary to the principle of justice and humanity of which America is a protagonist?"—*The Literary Digest,* Sept. 11, 1920.

JAPANESE EMIGRATION.—When California raises the cry of the "Yellow Peril," when Canada shuts her doors to the Japanese, and Australia proclaims her intention "to fight the Japanese influx to a finish," remarks *The East and West News* (New York), one wonders how many millions of Japanese are "invading" these countries. By way of needed illumination on the subject this weekly bulletin cites the data provided by the Foreign Office at Tokyo as follows:

"In the year 1911 there were 261,266 Japanese either residing or traveling abroad. The number reached 331,262 in 1913; 362,033 in 1915; 414,199 in 1916; 450,774 in 1917; 493,715 in 1918; and 582,435 in 1919. The returns of 1919 show that the United States was hostess to the greatest number of Japanese guests. She had a total of 125,195 Nipponese, of which 88,634 were male and 36,561 were female. Hawaii had 114,283 Japanese, which was about evenly divided between both sexes. Manchuria closely followed America, having 181,206 Japanese. China, including Tsing-tao, claims 59,109 Japanese. Hospitable Brazil fosters under her wing 31,349 men and women of Nippon. Mr. Hearst can rest assured that the Japanese invasion of Mexico is a remote affair, since there are only a handful of Japanese in Mexico—2198. Canada, with its vociferous clamor of Japanese peril, has only 16,650 Nipponese. Unless viewed in the light of a hallucination of the kind termed 'megalomania,' one is at a loss to find any explanation of Australia's excitement over the 'Japanese influx,' when she has only 2465 Japanese, with an annual average increase of less than one hundred. There were 47 Japanese in Africa and 1377 in Europe at the end of last year.—*The Literary Digest,* Oct. 9, 1920.

UNITED STATES

OUR LATEST BATTLESHIPS AND BATTLE CRUISERS.—Our latest battleships of the *Indiana* class, of 43,200 tons displacement and 23 knots speed, carrying twelve 16-inch guns, will be electrically driven. The turbines of 60,000 combined horsepower will develop their full rated load at 265 pounds pressure, 50 degrees superheat, and 28½ inches vacuum. The six new battle-cruisers of 43,500 horsepower and 35 knots speed, carrying eight 16-inch guns, will also be driven electrically. Two of them, the *Ranger* and the *Constellation* will carry four Westinghouse turbines of 49,750 brake horsepower, the current from which will be developed on eight Westinghouse motors, each of 22,500 horsepower.—*The Scientific American,* Sept. 25, 1920.

THE QUESTION OF PERSONNEL IN OUR NAVY.—Representative Fred A. Britten, of the House Committee on Naval Affairs, is right when he says that we should now give our attention to the rounding out of the fleet, the development of the merchant marine and the securing of an adequate and well-trained personnel. The first step to be taken is to secure men for the new ships which are now under construction. The navy should give equal if not greater attention to the question of personnel than to that

NAVY DEPARTMENT—BUREAU OF CONSTRUCTION AND REPAIR

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—DEGREE OF COMPLETION, AS REPORTED SEPTEMBER 30, 1920

Type, number and name	Contractor	Per cent of completion			
		Oct. 1, 1920		Sept. 1, 1920	
		Total	On ship	Total	On ship
Battleships					
44 California	Mare Island Navy Yard	94.2	92.6	93.6	91.8
45 Colorado	New York S. B. Cpn.	59.5	54.2	57.6	51.4
46 Maryland	Newport News S. B. & D. D. Co.	81.6	80.4	79.4	77.9
47 Washington	New York S. B. Cpn.	51.5	41.9	50.2	39.8
48 West Virginia	Newport News S. B. & D. D. Co.	33.5	19.5	32.5	17.5
49 South Dakota	New York Navy Yard	15.4	7.6	14.5	6.7
50 Indiana	New York Navy Yard	12.1	4.3	11.5	3.7
[1] 51 Montana	Mare Island Navy Yard	12.6	5.	11.2	4.
52 North Carolina	Norfolk Navy Yard	15.4	9.4	14.7	8.6
53 Iowa	Newport News S. B. & D. D. Co.	7.7	4.6	6.5	4.1
54 Massachusetts	Beth. S. B. Cpn. (Fore River)	....	....	....	......
Battle Cruisers					
1 Lexington	Beth. S. B. Cpn. (Fore River)	2.1	.3	1.3	.3
2 Constellation	Newport News S. B. & D. D. Co.	1.7	.3	.9	.1
[2] 3 Saratoga	New York S. B. Cpn.	4.2	1.1	3.1	.4
4 Ranger	Newport News S. B. & D. D. Co.	.8	.2	.7	......
[3] 5 Constitution	Phila. Navy Yard	1.1	.4	1.	.3
[4] 6 United States	Phila. Navy Yard	1.1	.4	1.	.3
Scout Cruisers					
4	Todd D. D. & Const. Cpn.	70.1	61.4	64.9	54.
5	Todd D. D. & Const. Cpn.	61.4	52.6	56.1	44.4
6	Todd D. D. & Const. Cpn.	40.6	19.6	37.4	14.8
7	Beth. S. B. Cpn. (Fore River)	18.2	8.	13.3	6.6
8	Beth. S. B. Cpn. (Fore River)	17.	7.5	12.6	5.9
9	Wm. Cramp & Sons Co.	53.	....	52.	......
10	Wm. Cramp & Sons Co.	52.	....	51.	......
11	Wm. Cramp & Sons Co.	29.	....	27.	......
12	Wm. Cramp & Sons Co.	29.	....	28.	......
13	Wm. Cramp & Sons Co.	22.	....	21.	......
Miscellaneous					
Fuel Ship No. 17, Neches	Boston Navy Yard	98.5	98.5	95.	94.3
Fuel Ship No. 18, Pecos	Boston Navy Yard	39.	34.5	36.	29.
Gunboat No. 22	Charleston Navy Yard	61.4	49.4	58.4	40.1
Hospital Ship No. 1, Relief	Phila. Navy Yard	98.5	98.	96.5	95.5
Amm. Ship No. 2, Nitro	Puget Sound Navy Yard	99.2	97.6	98.9	96.6
Rep. Ship No. 1, Medusa	Puget Sound Navy Yard	42.	35.	53.5	43.5
Destroyer Tender No. 3, Dobbin	Phila. Navy Yard	31.5	31.	29.7	29.
Dest. Tender No. 4, Whitney	Boston Navy Yard	3.	1.5	1.5	1.
Sub. Tender No. 3, Holland	Puget Sound Navy Yard	6.	....	5.5	......

[1] Battleship No. 51, keel laid September 1, 1920.
[2] Battle Cruiser. No. 3, keel laid September 25, 1920.
[3] Battle Cruiser, No. 5, keel laid September 25, 1920.
[4] Battle Cruiser, No. 6, keel laid September 25, 1920.

There are, in addition to the above, under various stages of construction 52 destroyers, 49 submarines, 1 oil tanker, and 3 sea-going tugs.

There were delivered to the Navy Department during September 1920, eight destroyers.

Authorized, but not under construction or contract 12 destroyers, 7 submarines and 1 transport.

of the completion of our new battleships and battle-cruisers.—*The Scientific American,* Sept. 25, 1920.

MERCHANT MARINE

AMERICA AND GERMANY AS SHIPMATES.—" There are always two sides to every question, but there seem to be three or four sides to the Harriman-Hamburg American ship merger," remarks the Buffalo *Express.* Certainly there are differences of opinion as to the extent that Germany will be benefited by the twenty-year "fifty-fifty" agreement entered into by these corporations, which has been discussed in former numbers of *The Literary Digest.* Such well-known men as Kermit Roosevelt and General Goethals have resigned from Harriman shipping interests, because, as report has it, they felt that Germany was being given aid at this time which in a few years would enable her to regain her prewar position in the shipping world; and the American Steamship Owners' Association of New York is "unalterably opposed to any contract with the Hamburg-American Line or any alliance with Germany," according to the New York *Times,* yet Admiral Benson, chairman of the Shipping Board, announces that he believes "the contract is a good thing, and in the end it will prove to be a good thing for the American merchant marine."

A. E. Clegg, vice-president of the Kerr Steamship Company, of the Harriman group, has also resigned from the presidency of the Kerr Navigation Corporation, another member of the Harriman combine, because, as he says, "the contract between the Harriman interests and the Hamburg-American Line is unfair to American shipping interests and unduly favorable to the Germans." After resigning, he and his partner sold to the Harriman interests their company stock for $4,900,000, and the money was immediately seized by federal officials, in order, it is said, to prevent the recipients (or one of them) from leaving the United States before paying excess-profits taxes, if they were found to be due, says *The Times.* Friends of Mr. Clegg and his partner, Mr. Kerr, however, declare that both men intended to reinvest the money in American shipping, in accordance with the Merchant Marine Act. These are the "three or four sides to the question" referred to by the Buffalo *Express.* Meanwhile, another decisive step in the shipping alliance between Germany and America is reported as taken by the North German Lloyds and the United States Mail Steamship Company, in an agreement identical in some respects with the Harriman contract.

General Goethals, former president of the American Ship and Commerce Corporation—the Harriman Company—and Kermit Roosevelt, former secretary, who recently resigned, made no statements explaining their action, but Mr. Clegg intimates that their resignations were actuated by the too-friendly attitude of the majority of the directors toward Hamburg-American interests. And to show that Germany is to gain from the agreement more than is her due, he quotes from an editorial in the Hamburg (Germany) *Schiffahrt-Zeitung,* which is said to represent Germany's attitude toward the twenty-year agreement:

"After the armistice and the signing of peace, many people thought that the Hamburg-American Line—and with it Germany—must renounce not only its fleet, but also the device: '*Mein Feld ist die Welt*' (my field is the world).

"Unflinching will, shrewd negotiations, and firm resolution to work anew have prevented the Entente from reaching the above aim. What the representatives of the *Hapag* (Hamburg-American Line), Managing Director Cuno and Director Hulderman, have brought back from New York is the first beginning of new-world influence. The agreement with the Harriman firm is the first step on the way from nothing to a new prime. The German flag will again wave over the ocean, and though the title be changed to *Hamburg-Amerika Linie Gemeinschaftdienst* (partnership service), the basis is German, and the hope remains that in twenty years the old Hamburg-American ships will again traverse the seas.

". . . . Each company has the right, under the agreement, to provide up to 50 per cent of the vessels required for every service. Actually, of course, Harriman will provide all the vessels at first, but the tonnage will be redistributed as the Hamburg-American fleet is rebuilt."

This redistribution of tonnage is one of the most striking points in favor of Germany, declares Mr. Clegg, and his friends believe it will tend to bring about a Congressional investigation of the whole shipping situation. Although each company is limited to 50 per cent in tonnage furnished, Mr. Clegg points out that as soon as new Hamburg-American ships are built, American vessels used on certain routes will be withdrawn in order to make room for the new German craft. Furthermore, goes on Mr. Clegg:

"The contract throughout is stamped with the German desire to be helped over the next five years, when probably only the Americans will have steamers. After five years every slip-up or default of the Americans is an advantage for the Germans for the balance of the contract period. Therefore Americans will act as a crutch for the German company for the next five years, and it is during these five years that, in the reconstruction of the world trades, the maritime nations will strive to get as great a portion of world carrying trade as is possible."

Other charges, which Mr. Clegg offers to substantiate before any authorized board or commission, are:

"1. The contract gives to the Germans 50 per cent of an American trade which otherwise would almost wholly be in the hands of American corporations.

"2. Forces the withdrawal of United States ships from services which they have made remunerative.

"3. Precludes the possibility of an American employing additional tonnage in particular trades which he has made profitable.

"4. In event of war the Americans will lose all advantages which have accrued to them during the period of development."

The Harriman and German interests, Mr. Clegg further asserts, are considering a "pooling interest and division of profits," but Admiral Benson definitely states that no such contract has been entered into, says the New York *Journal of Commerce*. "Admiral Benson," we read on, "thinks the agreement is for the best interests of the United States, and those who made it must have believed it for their own interests, so it is a fair question whether some foreign citizens are better guardians of our own interests than our own people." And Admiral Benson is quoted in the Philadelphia *Public Ledger* as saying that—

"If the United States is to make use, and prompt use, of the vast shipping material the war left on our hands, as well as the vast plant, with which we found ourselves, to manufacture new shipping, there could be no justification for our rejecting the partnership which the once premier steamship line of the world offered us. If we hadn't accepted the offer the British would have, and Scandinavian shippers are nibbling at it, too."

"So there is no occasion for special excitement" over the protest of the American Steamship Owners' Association over the Harriman-Hamburg-American agreement, declares the New York *World*, for—

"This corporation defendant to the accusations of the Steamship Owners' Association is as much an American concern as any ship or company represented in the association. It is presumably as capable of looking after its own interests and the interests of the American carrying trade in which it is engaged as any of these accusers. To imply, therefore, that it is engaged principally in fostering German interests and restoring Germany to the high seas where it was before the war is to fly in the face not alone of the probabilities of the case but of the facts as shown by the contract itself.

"The United States Government is not engaged directly or indirectly in keeping Germany off the seas for any purpose, and least of all for the purpose of fostering private monopoly in the carrying trade either in the interest of a special group of American shippers or in the interest of British shippers."

The interests of British shippers, however, seem to be well taken care of by England. Although Britain is said to have been outmaneuvered by the Shipping Board in the Harriman deal, the Government at Washington, says a special dispatch to the New York *World*, has received advices from London to the effect that 40 former German liners and cargo vessels, the best of several lines, which were awarded to England by the Reparations Commission, are to be sold to their former owners just as soon as existing laws preventing their sale can be amended by Parliament. This, however, in the opinion of Admiral Benson, will not adversely affect the Harriman combine with the Hamburg-American Line.

"There is not a single detail of this latter transaction that needs to be kept dark; there are no skeletons in ous closet," asserts Admiral Benson. "We have a lot of shipping that has to be set going or it will eat its head off." One of the ships that is said to be eating its head off" is the *Leviathan*—formerly the Hamburg-American *Vaterland*, which, we are told in the New York *Times*, "has deteriorated in the mud of her Hoboken dock to so great an extent that it will require an outlay of not less than $8,000,000 to put her again in condition for sea service." What makes matters more embarrassing for the chairman of the Shipping Board is that there are no bidders for the giant vessel. It was to prevent such waste as the *Leviathan* represents, we are told, that Admiral Benson favored the Harriman deal, which provides, he says:

"That the American merchant marine through the Harriman interests which are held to be 100 per cent American, obtains the good will and facilities of the company which previous to the war was the premier steamship line of the world."

Furthermore, adds the fighting Admiral, in denying the assertions made by Mr. Clegg:

"1. At no time either now or in the future can the Hamburg-American Line supply more than 50 per cent of the tonnage necessary to fill shipping requirements on routes established under the agreement.

"2. The Harriman line is to place at once on the various and especially favorable routes 400,000 tons of shipping.

"3. This tonnage can be augmented only when shipping demands augmentation and when it is necessary the Germans can place on any route only 50 per cent of the additional tonnage required.

"4. There is no provision in the agreement for a division or pooling of gross earnings, but the American lines are to retain earnings of American ships, and only that earned by German ships will go to the Hamburg-American Line."

Everything considered, says the New York *Times*—

"Admiral Benson may be right, but even his word should not be taken as final. Before the contract with the Hamburg-American Line goes into operation it should be considered from every angle, and each clause should be scanned to detect mischief to the American Merchant marine. Let the search-light of publicity be turned on every recess of it. Better to be safe than to be sorry. American interests must come first."—*The Literary Digest*, Sept. 25, 1920.

HARRIMAN CALLS GERMAN SHIP DEAL BIG OPPORTUNITY.—Mr. Harriman's statement issued yesterday read as follows:

"W. A. Harriman, President of the American Ship and Commerce Corporation, in making public the agreement with the Hamburg-American Line, invites a study of the contract with particular reference to the following points:

"1. The American company pays no money to the Hamburg line except for service actually rendered to the American company by the Hamburg line.

"2. The contract gives to the American company the use of its facilities, experience, and established trade routes of the Hamburg-American line.

"3. During the twenty years of the contract, the American company has complete control of all activities of the Hamburg line in the United States.

"4. The contract gives the American company the right to participate in 50 per cent of all business originated in Hamburg by the most important shipping agency in Germany. Without this contract the American company would have not right whatever to participate in that business.

Obliged Only to Act as Agent.—"5. On its part the American Company assumes but one definite obligation, namely, to act as agent in American ports for the Hamburg Line. In all other respects the American Company shall put its money and effort only in directions which appear to it to be profitable.

"If the contract were not made with an American company, it could be made with a company of some other country.

"6. The American company is not obligated to inaugurate any service except the limited passenger service for which ships have already been arranged, unless its investigations lead it to the conclusion that such service promises a profitable result.

"7. When these negotiations were pending originally between the Hamburg-American Line's American representative and the United States Shipping Board, the details of the proposed agreement were placed before the Senate Committee on Commerce and that such an agreement had that body's sanction by a vote of ten to four.

"8. Provision is made for entry into the services of certain freight ships which the Hamburg-American Line is now having built.

"The Hamburg-American line ships now building and to which this provision applies now aggregate only about 185,000 tons, or in the neighborhood of 8 per cent of the total amount of tonnage engaged in the various services before the war.

"The Hamburg-American line must give the American shipping interests one year's written notice of the date at which it is expected the building of each of these ships will be completed and the service or services in which it is intended to enter such ships. Such ships shall be allocated proportionately to the existing freight services or new services to be inaugurated with the 50 per cent proportion, thereby avoiding the withdrawal of American steamers wholly from the remunerative services. No American ships can be asked to withdraw from the American service. Furthermore, the conditions of the clause cease to be operative when 185,000 tons have been entered into the service.

Withdrawal of Tonnage.—"9. It is provided that when and if it is found that through causes which could not be foreseen, more tonnage had been inserted in any particular service than proved necessary, it is to be reduced down to the necessities of the trade, but that both parties are to withdraw in proportion to their previous participation. The tonnage so withdrawn can be placed in other established services or for the inauguration of new services. In neither case need it be assumed that these already established services or even new ones should necessarily be unremunerative.

"10. Section 11 of the contract provides that if a service is being conducted by one of the parties only, that party is permitted to withdraw all or any of its ships on three months' notice. This means that if the American shipping interests elect to take up one of the services without the Hamburg-American Line as a participant, and upon a demonstration it is found such services do not promise profit, the Americans may withdraw their steamers and there is nothing in the section that prohibits their engaging alone or with the Hamburg-American Line in a revival of that service when conditions are believed to be propitious.

"11. It is provided that either party may withdraw from any service in case ships are actually being operated at a loss. In the latter case. the notice of the withdrawing party is fixed at a six month's period which is about the minimum time in which it can be established. Any steamers so withdrawn can be employed in other established services under the agreement or in the inauguration of other services, whichever may seem the

more remunerative. It is not possible to foresee, with services spread all over the world, the future outcome of each one. Any ships may be withdrawn entirely upon one year's notice for any reason whatsoever from services not touching America."

Elasticity of Agreement.—"The whole agreement has been made with a great amount of elasticity so that ships that find unremunerative employment in one service can be transferred to another without detriment to the interests of the American company.

"And finally, with reasonable notices, they can be taken out of the trade altogether. Indeed, all through the agreement there is the right of substitution of ships; for example, if it is demonstrated that one type or speed of ship proves to be not the right one, then either party can substitute a class of ship that is best suited. This privilege can often change unremunerative service into a profitable one.

"12. It is stipulated that where one party acts for the other there shall be a fixed fee per steamer for management. This was copied from the Shipping Board practice. In its handling of steamers in Hamburg, the Hamburg-American Line is rendering a service for which they, as agents of those steamers, are justly entitled to remuneration. In the same manner, when German ships are in American waters, the American companies are entitled to charge for the service they may render to the German ships.

"13. All cargo via American ships intended for trans-shipment by water to ports beyond are given preferential treatment on space by the Hamburg-American Line over cargo via other ships if the connecting steamer is owned by the Hamburg-American Line, and the Hamburg-American Line cannot charge any higher rate from Hamburg than it charges to others or than is charged by others. In other words, the Hamburg-American Line must meet market rates from Hamburg on all trans-shipped cargo, whether the cargo is carried in their own coastal steamers or not.

"15. The Shipping Board has not yet assigned any government or ex-German ships to the American company, nor has formal request for such assignment been made on it, and the American company has so far planned to use only its own privately owned or controlled ships.

"16. The American Company has signed away no right or privilege which could be reserved for an American company. The contract restricts no enterprise or activity on the part of American shipping; on the contrary, at one bound, it places an American shipping company in position to participate immediately in the most promising trade services in the world.

"We regard the whole undertaking as a brilliant American opportunity."—*The New York Times,* Sept. 6, 1920.

APPROVAL NOT NECESSARY.—Washington, Oct. 6.—It is not necessary for the Shipping Board to give its approval to the contract made between the Hamburg-American Line and the American Ship and Commerce Corporation, unless ships belonging to the board are operated by the combination. This was learned this afternoon from Admiral W. S. Benson, Chairman of the Shipping Board.

Admiral Benson has given his personal sanction to the contract, and repeated to-day that he believed the agreement was a splendid thing for the development of the American interests in the North Atlantic. The board has not yet approved the contract although an official statement issued some time ago unwittingly stated that this was the case.

Chairman Benson stated that the Harriman-Hamburg American combination would probably seek the approval of the board as while it proposed at this time to operate its own fleet, it might in future ask the Shipping Board to allocate vessels to it. This was only a contingency, the Admiral indicated.

While the board's official sanction is not mandatory for the contract, it is necessary for the North German Lloyd-U. S. Mail Steamship Company contract to receive it.

This company is operating vessels belonging to the Shipping Board.—*The New York Times,* Sept. 6, 1920.

TWENTY-EIGHT THOUSAND SHIPS OF 16,000,000 TONS IN AMERICAN MERCHANT MARINE.—At the end of the fiscal year June 30, 1920, the total American registered, enrolled and licensed shipping, according to the returns of the Bureau of Navigation, Department of Commerce, consisted of 28,182 vessels, of 16,324,013 gross tons, compared with 27,513 vessels, of 12,907,300 gross tons, on June 30, 1919. Of the year's increase nearly 90 per cent consists of seagoing ships of 1000 gross tons or over built at public expense and owned by the United States Shipping Board which increased by 648 ships, of 3,075,925 gross tons, during the year, standing 1630 ships, of 6,903,128 gross tons, on June 30, 1920.

At that date the total American documented fleet consisted of 8103 steam vessels of 13,466,400 gross tons 4030 sail vessels, including rigged barges of 1,272,160 gross tons, 4891 unrigged barges of 1,176,604 gross tons, 10,710 motor vessels of 357,037 gross tons and 448 documented canal boats of 51,752 gross tons.

On June 30, of the total fleet 5958 vessels of 9,928,595 gross tons were registered for foreign trade, compared with 5032 of 6,669,726 gross tons on June 30, 1919, the year's increase thus being almost wholly in foreign trade ships.

Tonnage enrolled and licensed for coasting trade numbered 22,224 vessels of 6,395,418 gross tons, compared with 22,481 of 6,237,574 on June 30, 1919.—*Shipping*, Sept. 25, 1920.

THOUSANDS OF MERCHANT MARINE OFFICERS.—More than 13,000 merchant marine officers have been graduated from the Shipping Board's training schools since their establishment three years ago and 72 per cent of the graduates have been licensed for service at sea as records of the Board's recruiting service show.

Officers for the government owned merchant marine are trained at Camp Stuart, Va., San Francisco and Seattle. Four wooden ships operate on the Atlantic coast as combination training ships and cargo carriers. Each has a capacity of 200 apprentices and 1200 tons of cargo.

On the Pacific coast one wooden ship carrying 1800 tons of cargo and 115 apprentices and a new 1800 ton steel vessel with space for 146 apprentices operate on the triangular run between Seattle, the Hawaiian Islands and San Francisco.

Extension and development of its system of training Americans to command the craft of the merchant marine is planned by the Shipping Board. It is suggested that shore stations be maintained where men from all sections of the country can be assembled and given instruction in seamanship, boat drill and other preliminary work.

The men would then be sent to sea in modern steel freight ships which would be utilized as combination cargo carriers and training vessels, carrying about 125 apprentices. It is planned to place these ships in a trade which would insure a voyage out and return in about 60 days, 4 vessels on the Atlantic and 2 on the Pacific.

Concurrently with the sea training the recruiting service plans the establishment at colleges and universities near the principal American ports of a maritime commerce course which would include accounting, business correspondence, business principles, economics, elements of statistics, markets, transportation, principles of foreign trade, exports and imports, languages, railroad and maritime rates, business administration, business law, admiralty law, advertising, ship operation and other basic subjects.—*Shipping*, Sept. 25, 1920.

AERONAUTICS

AVIATION.—It is quite possible that the future historian will set down the present year as marking a new era in the history of aviation—the era of metal construction. As an advocate from the very first of the monoplane as against the multi-winged type, we are gratified to note that, so far as America is concerned, two of her entries for the approaching international cup contest are of the monoplane type, and that the most important of

the new airplane postal routes, that from New York to San Francisco, is being operated by all-metal monoplanes. The monoplane is ideal for high speed, and because of its lower head resistance, or drift, it is the most economical type at any speed. It has been built in fairly large sizes, although, for the present, it seems likely that in the largest airplanes, recourse will be had to the biplane type. Excellent progress is being made in the development of a more effective form of wing, and unquestionably the airplane of the future will be capable of changing the angle of incidence during flight. When this has been done, the difficulties and dangers of taking off and landing will be reduced to a minimum, and the pilot will have a wider range of choice for a landing place in cases of forced descent. Similarly, in the near future we look to see a thoroughly reliable variable pitch propeller put upon the market. Results obtained with this device at the Army Flying Grounds at McCook Field are very encouraging; for it has been found practicable to change the pitch of the propeller to suit the altitude, and also to reverse it entirely at the moment of landing, thereby securing a braking effect, so powerful as to bring the machine very quickly to rest after it has reached the ground.

There will be a steady increase in the size both of airplanes and dirigibles. It is now realized that there is no inherent disadvantage, as was at first supposed, resulting from increase of size in the airplane. At the present time a seaplane is under construction which has a wing spread of nearly 250 feet; whose weight is over 50 tons, and whose radius is over 4000 miles on one filling of the fuel tanks. The boat is of such size that full stateroom accommodation is provided for a considerable complement of passengers and crew. This is an enormous advance at one stride, and suggests that future airplanes and seaplanes may ultimately rival the smaller ocean-going steamships in dimensions. Reliability will be assured by a multiplicity of engines, the flying boat above mentioned having no less than eight, with a total capacity of nearly 5000 horsepower. As far as the dirigible is concerned, any increase in dimensions brings with it a greater relative increase in carrying power and all-around efficiency. Now that the question of landing has been solved by the provision of mooring towers, the risk of landing, even in heavy weather, has been eliminated. The flight of *R-34* last summer from England to America and back has established the feasibility of trans-oceanic travel, and the last machine to be completed, *R-80*, in its recent trial trips has shown great improvement in control and maneuverability over *R-34*. This latest of the dirigibles has a cruising radius of 6400 miles and a maximum speed of 65 miles per hour. Aerial travel will be divided between the two types, the dirigible being used for long distance and trans-oceanic travel, while the airplane will be the standard machine on overland routes, where the distances between stops are shorter. Experimental work which is being carried on in this country in producing a steam drive for airplane service has given such promising results, that it is quite possible a combined steam boiler and steam turbine, admirably adapted for the larger machines, will be in extensive use within the next few years. One of the great advantages possessed by steam-driven airplanes would be the absence of the loud exhaust, an improvement which will be especially appreciated by the airplane passenger, and will prove to be of great tactical advantage in naval and military airplane service.—*The Scientific American*, Oct. 2, 1920.

NAVAL AIRCRAFT TO PARTICIPATE IN PACIFIC FLEET MANEUVERS.—When the Pacific fleet moves south the latter part of this month, and concentrates for several days of battle manuevers and target practice, there will fly with it a great air fleet comprising every known type of aircraft. In this air fleet will be some of the navy's newest and latest aerial fighters—the torpedo planes. The Fleet Air Detachment possesses several squadrons of these new air weapons and will have an ample opportunity to test their merits during the coming maneuvers, which will mark their first appearance at such an engagement.

Seaplanes will carry on raids and bombing sorties against the seacraft simultaneously with the torpedo attack. Fast scout planes, carried on the decks of the big ships will attempt to outmaneuver and drive away the big and less speedy enemy which will also be protected in their raids by agile scouts.

The sham battle will develop into one of sea power versus air power. The outcome of these tactical maneuvers between fighters of the sky and fighters of the sea is at present problematical. If the torpedo-planes aided by the huge seaplanes and protected by speedy scouting planes can bewilder the anti-aircraft and ship planes, and thereby destroy the battleships, it will conclusively demonstrate the potency of the aerial fighter and bring it to the foreground as the future main arm of defense.

The combined Atlantic and Pacific fleets will assemble off Panama after the first of the year, to engage in the great annual battle practice and maneuvers. Seaplanes, including torpedo planes, land planes, dirigibles and kite balloons will be used to a greater extent than ever before.

Aerial smoke bombs will be dropped from the sky to form a curtain of protection for the dreadnaughts against the more mobile cruisers and destroyers. Aerial torpedoes will be launched from planes swooping down from above.

In both maneuvers, that of the Pacific fleet alone the later part of this month and that of the combined American fleet off Panama, the deciding factors will turn out to be the aircraft.—*The Aerial Age Weekly*, Sept. 20, 1920.

ATLANTIC FLEET TORPEDOPLANE DIVISION.—Activities of the U. S. Atlantic Fleet Torpedoplane Division are to include a test of the Navy Martin bombing and torpedoplane on a field set apart for this purpose at Yorktown, Va. Lieuts. H. J. Brow, G. C. Miller and T. N. Thweatt, U. S. N., who have reported to the Director of Naval Aviation, have been assigned to duty qualifying in these new aircraft. They have been making flights in the vicinity of Washington from the navy aviation station at Anacostia, D. C. If the field proves satisfactory, operations in torpedo and bomb dropping will be begun at Yorktown as soon as hangars and other buildings now under establishment and maintenance of this base will cost approximately $35,000, according to data submitted by Lieut. Commander Harold T. Bartlett, U. S. N., in charge of administration at the naval air station, Pensacola, Fla.—*The Aerial Age Weekly*, Sept. 13, 1920.

THE B. M. W. AERO ENGINES.—The B. M. W. (Bayerische Motoren Werke) aero engine has aroused considerable interest because of the remarkable performances which have recently been established in the United States by the *JL-6* all-metal monoplanes which are equipped with this power plant.

The B. M. W. engines are designed as super compression high altitude engines and must be regarded as pioneer efforts in this field of aero engine construction. The qualities of these engines are exemplified by the following four points:

1. Simplicity of construction, easy manipulation, reliability and great strength, insensibility to external influences even when being handled by inexperienced pilots.

2. Remarkably low fuel consumption even when using low-grade fuel with almost fully throttled motor flying at great heights. Consequently, great range of action at high speed and low cost of running, which is an important factor for aerial post service and traffic.

3. Constant output up to very great altitudes. A minimum decrease of power only at abnormal heights. (It is a well-known fact that the usual type of aero engine greatly diminishes in efficiency as the height increases; a drawback which becomes noticeable ready at comparatively low altitudes.)

4. Possibility of temporarily overtaxing the motor by fully 20 per cent above its normal output. (This is of very great importance when starting

from difficult ground, rough sea, and especially when carrying abnormally heavy loads and for overcoming sudden handicaps.)

Special Features.—Up to a normal output of 220 horepower the propeller is coupled directly to the crankshaft. The more powerful types have a specially designed reduction gear.

A remarkable feature of the B. M. W. altitude motor is that the revolutions per minute of the propeller increase with the increase in height, whereas in the usual type of engine the revolutions per minute decrease. For example, the type B. M. W. III A. increases by about 150 and B. M. W. IV by about 180 revolutions per minute. These facts have to be considered when choosing the respective propellers.

Cylinders.—These are made from a special steel and the cooling jackets are made of steel-plate welded to the cylinders.

Pistons.—The pistons consist of a high-grade aluminium alloy. The pistons, apart from the advantage of being of low weight, possess most favorable heat-conducting qualities; these qualities adding greatly to the remarkable smooth working and reliability of the motor.

Crankcase.—This also consists of cast aluminium and is braced by strong hollow cross ribs through which the combustion air is drawn into the carburetor, thus enabling an effective cooling of the bearings within the crankcase. On its way to the carburetor the current of fresh air passes between the bottom of the lower crankcase and an aluminium casing thereto; it also passes the ribbed oil chambers and thus effects an additional cooling of the crankcase as well as of the oil contained therein.

Valve and Valve Gear.—Both the admission and the exhaust valves are set at an angle in the cylinder heads. They are opened and closed by rocking levers operated by the cams on a camshaft. This valve-operating gear is oil-tight within a casing above the cylinders, and the camshaft is driven by means of bevel wheels from a vertical shaft on the suction side of the motor. This shaft, which also drives both magnetos, can in addition be used for driving any auxiliary apparatus which may be ordered with the motor.

Carburetor.—All B. M. W. motors for aerial purposes are fitted with a patent high-altitude carburetor which guarantees minimum fuel consumption at all altitudes, even when throttled. This carburetor, by reason of its special design, has played an important part in the achievements of these engines.

Fuel.—The B. M. W. motors may be driven on light gasoline, heavy gasoline, benzole, or any of the usual mixtures without any alteration having to be made.

Ignition.—Ignition is produced by two bevel wheel driving high-tension Bosch magnetos mounted at the suction side of the motor and co-operating each with one set of sparking plugs.

Lubrication.—The lubricating system is most carefully devised; it is a continuous system wherein the oil is circulated by a pump. After completing its circuit the oil is collected in the crankcase to be used again together with an addition of a small quantity of fresh oil. The oil level is maintained at a constant height by a fresh-oil and a scavenging pump. Inclined positions of the motor do not affect the lubrication.

The engines are fitted with all the accessories of modern motor engineering, such as half-compression devices, air pressure pumps, pre-heating arrangements, etc., and if desired can be provided with wireless installation, lighting and heating set, etc., without difficulty.

Type of motor	BMW II	BMW IIIA	BMW IV
Horsepower	120	185	220
Number of cylinders	6	6	6
Bore (inches)	4.7	5.9	6.3
Stroke (inches)	6.3	7.1	7.5
Continuous normal output at ground level at 1400 revs. per min. (h. p.)	140	185	220

Normal number of revolutions of propeller per minute	1,400	1,400	1,400
Output remains constant to a height of (feet)	——	11,700	15,000
Output can be temporarily increased at ground level to (h. p.)	——	240	265
Fuel consumption per h. p. hour (oz.)	8.1	7	6.7
Lubricating oil per h. p. hour (oz.)	0.42	0.35	0.28
Service weight of engine, excluding water, oil and propeller hub (* including reducing gear) (lb.)	465	*630	650
Weight of cooling water (lb.)	19	27.5	22
Weight of oil in crank casing (lb.)	7.7	8.8	8.8
Weight of propeller hub (lb.)	11.4	14.4	14.4

Particulars of the B. M. W. Engines.—The following further data which were published by the British Air Ministry amplifying the foregoing.

The general arrangement follows very closely standard German practice, the outstanding features being the very high compression ratio of 6.42 to 1 and the novel-carburetor.

The cylinder construction is simple, barrel and head being machined from one forging, with valve pockets pressed and welded into the heads. The valves are inclined at an included angle of 30 degrees.

Both inlet and exhaust valve stems are water-surrounded, recesses being formed in the valve pockets as shown clearly in a sketch.

Pistons.—The pistons are strongly ribbed and of excellent material; they are fitted each with three narrow concentric piston rings, which are internally peened for half their circumference.

Steel bushes are cast into the gudgeon pin bosses, and the gudgeon pin is held therein by a setscrew.

Connecting Rods.—The connecting rods are of tubular section, machined all over, and taper slightly in outside diameter. Floating gudgeon pin bushes are fitted to the small ends. The big ends are fitted with two bolts only.

Phosphor bronze big-end shells lined with white metal are used, and the bronze shells are cut with an internal screw thread to give a seating for the lining.

The tubular connecting rods act as oil ducts to the gudgeon pin bearing. Instead of the usual small pipe leading up the con rod, the bottom end of the rod is fitted with a steel disc plug whereinto a small 4 mm. tube projecting up into the rod for about 40 mm. is screwed. A further small hole is drilled through into the little end from the interior bore of the rod.

Valves and Valve Gear.—Inlet and exhaust valves are of similar form and size, of 72 mm. maximum diameter, 13 mm. stem diameter and of an overall length of 153.5 mm.

Single springs are fitted to the inlet valves, and concentric double springs to the exhaust valves. The spring washers are screwed onto threads cut in the valve stem end and locked by split-pins.

Camshaft.—The camshaft follows very closely Mercedes practice, but in the casing a steel forging machined all over replaces the malleable casting used in the prototype, and the valve rocker covers are of aluminium. Some 7½ pounds is thereby saved.

Crankshaft.—The illustration shows the formation of the crankshaft. The cross-section of the shaft and of the crank pins increases progressively from the magneto end to the airscrew end—owing to the diameter of the bore being successively reduced.

Flanged brass discs, expanded into grooves, close the ends of each of the holes.

A single ball thrust race, housed in a split steel casing in the crankcase, is fitted at the airscrew end.

Crankshaft bearings are steel shells, white metal lined, with an internal thread in the shells similar to those of the big ends.

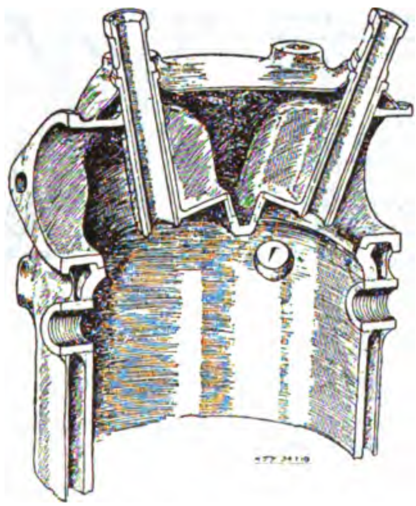
The Carburetor.—The carburetor is of very unusual design. It is shown in a sketch. It consists really of three carburetors with a common float chamber. Each of these carburetors has a separate induction pipe leading up to the induction manifold.

The central carburetor has two jets—a pilot and a main jet. The outer two carburetors have one jet each. Five throttle valves are employed, arranged in two systems with independent control. The main system comprises three throttles, one to each carburetor.

The secondary system—which is an altitude control—has two valves on the two outer carburetors.

The action is described as follows:

When the main throttle is opened slightly, the pilot jet only (center carburetor) is in action and mixture from the central carburetor alone reaches the cylinders. As the throttle is opened further the main jet comes into action, and the center carburetor supplies the whole mixture till the throttle is half open. After this the two side carburetors come into action.



SECTION OF THE B. M. W. CYLINDER HEAD.

Only a relatively rich mixture is supplied by the two side carburetors, as the secondary throttles are closed and have only relatively small slots in them to pass gas, and the actual mixture supplied to the engine under these conditions is correct for ground level running.

Opening the secondary system of throttles reduces the strength of the mixture from the side carburetors and acts as an altitude control.

It is obvious—in view of the B. M. W. firm's statement—that half throttle, or the point where the side carburetors just do not supply any gas, is the normal continuous ground level full power position, and that the opening of the two side carburetors is only to be used for emergencies at ground level, and as altitude is gained.

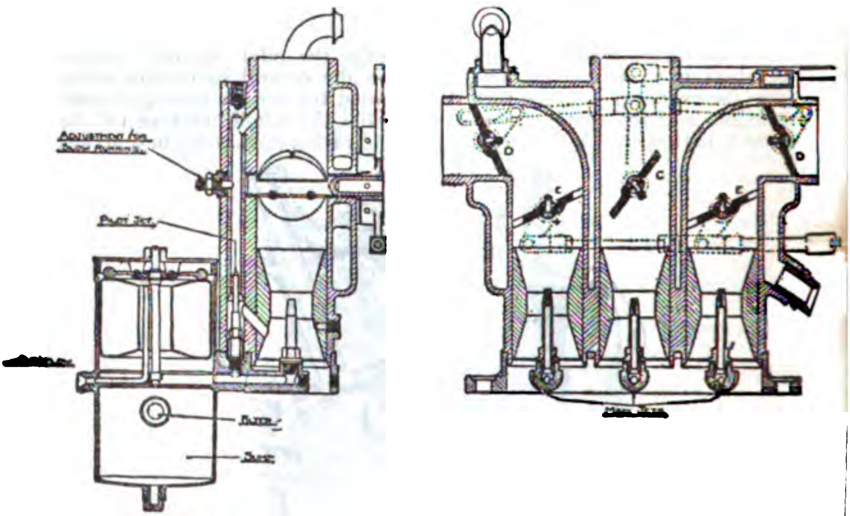
The following figures of a one-hour test are of interest:

Average r. p. m., 1400.
Average b. h. p., 216.
Average water inlet temperature, 63° C.
Average water outlet temperature, 74° C.
Average oil pressure, 24 lb. sq in.
Oil consumption, 8 pts. per hr.—0.037 pts. per h. p. hr.
Fuel consumption (50 per cent benzol), 94 pints per hour = 0.431 lb. h. p. hr.

Consumption figures from other tests are given as:

R. P. M.	1,200	1,400	1,600
B. H. P.	203	234	254
Fuel (lb. per h. p. hour)	0.412	0.418	0.421

It will be seen that these figures show a very fair agreement with the makers' claim of 7 oz. per h. p. hour, which is 0.437 lb. when throttled to 185 h. p. at 1400 r. p. m.



SECTIONS OF THE B. M. W. CARBURETOR.

The weight of the captured example is given at 643.5 lb., or slightly heavier than the makers' figure.

Altogether the engine must be acknowledged to be a very interesting piece of work, and its overload tests at the R. A. E. would seem to indicate that it is very conservatively rated by its makers.—*The Aerial Age Weekly*, Sept. 13, 1920.

THE BAKER AIR SEXTANT.—One of the difficulties in using an ordinary sextant in aircraft lies in the uncertainty as to the depression of the visible horizon below the true horizontal

In order to avoid this uncertain correction to the altitude of the heavenly body observed, the sextant described in this paper has been designed to utilize the part of the horizon directly below the sun and star, and also that part in the opposite azimuth. This is accomplished by the use of two prisms placed above the object glass of the observing telescope. The reflecting faces of the prisms are at right angles to one another and as a result the field of view consists of an erect view of the front horizon and an inverted view of the back horizon. The index prism, which is above the two horizon prisms, can be rotated about an axis parallel to the reflecting faces of the horizon prisms; it is used like the index mirror of an ordinary sextant to reflect the image of the sun into the field of view. Light from the sun, after reflection at this prism, passes into the telescope system through a small circular hole drilled centrally through the two horizon prisms. By this index prism the image of the sun is brought down to bisect the space between the two visible horizons, thus dispensing with all corrections for the dip of the horizon and the semi-diameter of the

sun. The rotation of the index prism is actuated by a worm and worm wheel, the spindle of the worm having a divided head at the top and a knurled head at the bottom for moving it. Each 10 degrees is marked on the worm wheel, the intermediate degrees and minutes being read on the divided head, the smallest division of which represents 10 minutes. It is possible to read the position of the index prism to two or three minutes. The main part of the telescope is vertical, a reflecting prism being introduced into the eye-piece system so as to enable the observer to look into the instrument in a horizontal direction. (Instr.-Commander T. Y. Baker, R. N., B. A., *Transactions of the Optical Society*, vol. 20, No. 9, 1919.—*The Technical Review*, Aug. 31, 1920.

ENGINEERING

NEW TYPE AUTOMATIC CO_2 RECORDERS.—The article describes many new instruments for recording the percentage of CO_2 in flue gases.

They all differ substantially both in design and in construction, and are divided in three classes, according to the principle involved, *e. g.*, (1) Result derived directly from the weight of the gases; (2) result depends upon the ratio between the specific weight of the flue gases and air; (3) result depends upon the refraction of light.

Representative of the first type are:

(*a*) The Luxsche gas balance, which consists of a hollow ball placed on a hollow spindle and capable of being balanced with a long thin pointer fitted with an adjustable weight. Gas drawn from the boiler flues through an india-rubber tube reaches the remote side of the ball through the hollow spindle and a small bore brass tube inside the ball, from whence it passes through a fine opening to the opposite side of the hollow spindle. The pointer then indicates the percentage of carbon dioxide on a graduated scale.

(*b*) The Econometer consists of a delicate chemical balance having an egg-shaped container suspended from each arm. One is hermetically sealed and the air partly exhausted, the other terminates in a tube connected to an air-trap, and a central tube admits flue gas to the upper part of the container through a second tube in the air-trap. The entire apparatus is enclosed in an air-tight case, no packing of any kind being required for the air-trap or the central tube, and the balance is perfectly free. The percentage of carbon dioxide is read off a scale by means of a pointer.

Type 2:

(*c*) The Dasymeter. In this apparatus a hollow glass ball, filled with air, is balanced in an enclosed chamber with glass walls. The flue gases are drawn through the chamber itself, the glass ball being provided with a pointer which indicates the weight of the surrounding gas compared with the weight of the hollow ball.

(*d*) The Schulze-Krell flue-gas analyzer determines the specific weight of the gases by automatically recording the weight of the volume of flue gas in a vertical standpipe and the weight of air in a second pipe of the same height. Both pipes communicate with a delicate micro-anemometer which indicates the difference. For continuous service it is essential that both the flue-gas and the atmospheric air pass through the standpipes, but as the apparatus has no moving parts this condition is readily complied with.

(*e*) Ubbelohde and Dommers flue-gas analyzer determines the specific gravity of the gas by drawing gas and air at equal pressure and temperature through small holes in thin plates. The volumes thus obtained are proportional to the specific gravity and are determined by ordinary gas meters through which they are passed by a Bunsen water-jet pump. A differential gear attached to the clockwork actuates an ink pointer and produces a continuous record of the proportion of carbon dioxide. Readings obtained with this apparatus, although sufficiently close for practical purposes, are not absolutely true.

(*f*) The Telezometer determines the specific gravity of flue gas and air by centrifugal force. It consists of two small fans mounted on a common shaft and rotated at a uniform velocity, one drawing air and the other gas through the apparatus. The specific weight of the flue gas is indicated on a double differential pressure gauge and transferred to a revolving drum giving a continuous diagram. The accuracy is well within the requirements of ordinary practice.

(*g*) Dommers flue-gas analyzer depends upon the capillary attraction set up when flue gas is drawn through a narrow tube. Details are not given, but the inventor claims that the apparatus is capable of recording continuously with a tolerance of one-half per cent, and that it is independent of pressure and temperature.

Type 3:

(*h*) The Gas-Refraktometer, by Haber, made by Karl Zeiss in Jena, consists principally of a glass prism with a refractive angle of 160° through which is drawn the gas to be tested, while the air with which it is compared is drawn through an enclosure round the prism. The light of a Nernst lamp passes through the prism and a telescope to an inclined mirror from which the rays are reflected and slightly displaced laterally. The edge of the prism appears as a dark shadow according to the refractive power of the gas, and can be readily observed on a scale through a microscope. A record is made photographically on a revolving drum. The apparatus is subject to 0.1 error for every 2 per cent difference in the barometric pressure and to a similar error for each 6 per cent variation in temperature of the gases. On account of the design adopted the latter error is very slight and the apparatus is considered the most accurate known at present. (Dr. Otto Braun, *Journal für Gasbeleuchtung*, May 15, 1920.)—*The Technical Review*, Aug. 31, 1920.

PULVERIZED COAL AND ITS FUTURE.—The author, after giving reasons for the failure of some of the earlier attempts to burn pulverized coal under stationary boilers, deals successively with the conditions requisite for the successful use of pulverized coal as fuel, the chief advantages obtained. the cost preparation, the method of preparation, and the questions of ash dissipation and smokeless operation.

From 12 to 15 t. of pulverized coal is being used annually in the United States to-day. The velocity of the gases of combustion through the furnace should not exceed 7 ft./sec., which equals approximately 2 cub. ft. of furnace volume per boiler h. p. developed, assuming nearly cubical form of combustion chamber. Pulverization of the coal ensures intimate mixing of the coal and air, gives nearly perfect combustion, a lower percentage of excess air is required, and a very high efficiency is attained.

The standard degree of fineness is 95 per cent through the 100 mesh sieve and 85 per cent through the 200 mesh sieve. All grades of coal can be used successfully in the pulverized form, including lignite coal and waste fuels from mining operations. Other advantages are the elimination of stand-by losses, the absence of clinkers, ease of control, ease of ash removal, and the almost complete absence of smoke.

Dealing with the cost of preparation, the author gives a table showing the cost of various items per t. of fuel prepared for plants with a daily capacity of from 20 to 1120 t. It is argued that the cost of pulverizing and drying the fuel is no greater than the cost of handling coal with the best types of mechanical stokers. The method of preparation is described and it is stated that with reasonable care there is practically no danger of explosion occurring either during the preparation or in the use of the fuel. (H. C. Barnhurst. Paper read before the Philadelphia Section, American Society of Mechanical Engineers. *Marine Engineer and Naval Architect*, June, 1920.)—*The Technical Review*, Aug. 31, 1920.

PULVERIZED COAL FOR ITALIAN LOCOMOTIVES.—Owing to the acute shortage of fuel in Italy, the Italian State Railways equipped two of their new heavy

Consolidation type locomotives for burning pulverized fuel, to enable them to utilize the native deposits of lignite.

Average Italian lignite analyses ash 10 per cent, volatiles 40 per cent, fixed carbon 30 per cent, moisture 20 per cent. The pulverized-fuel locomotives are to be operated between Rome and Viterbo, a distance of 80 kilometers. The two sets of pulverized fuel apparatus were applied to two of a batch of locomotives, practically the only tender change being the substitution of a U-shaped tank moved bodily on the tender frame 7 inches to the rear in order to distribute the weight better on the front and rear trucks. It was possible to install the equipment without altering the water legs from the standard design, except for the altering of a hand-brake handle. The tank holds ten metric tons, as only one pulverizing plant is to be at first installed.

A tube-supported brick arch is placed in the firebox and the sides of the combustion chamber beneath the firebox proper are bricked up with air vents controlled by dampers. The feed screws are driven by a two-cylinder double-acting reciprocating engine, giving a wide variation on a minimum steam consumption. The screws can be started up and operated on a 25-pound steam pressure. The screws are operated in pairs so that the coal cannot arch over, and a steady constant feed is obtained.

The pulverizing plant ordered consists of two standard 42-inch screen-type pulverizing mills, of 4 tons per hour capacity each, and a drier fired by pulverized coal and having a capacity of 10 tons of dried coal per hour. The coal plant is a track hopper for receiving the coal from the cars, a single roll crusher, a magnetic separator, and conveyors, with a 40-ton storage bin placed over the track. The locomotives are coaled through butterfly valves with filling spouts. The plant is driven throughout with electric motors, and is equipped with dust collectors and separators. (*Railway Age*, May 7, 1920.)—*The Technical Review*, Aug. 31, 1920.

GERMANS BUILDING DIESEL ENGINES OF 12,000 H. P.—Simultaneously with the first published description of the 22,000-ton German tank steamer *Zoppot*, we are able to state with certainty, says *Motorship*, that German engineers have completed and run shop trials of two 12,000 shaft horsepower marine Diesel engines, and that these motors are of the double-acting 2-cycle type. These engines represent the greatest advance in the modern marine engineering field, and bring the economical Diesel oil engine within the possibilities of large transatlantic liners. The accomplishment smashes the assertion of many that the internal-combustion oil motor is limited to modern-sized vessels. In 1910 the highest-powered ocean motor ship was a little tanker of 500 shaft horsepower. From 500 to 12,000 horsepower in 10 years is wonderful progress. One might say that the transatlantic motor liner is on the verge of attainment.

American shipowners, to whom the success of the American Diesel engine means so much, must lend financial and moral support to ship and engine builders without dallying, or otherwise be wiped off ocean trade routes within a few years. Shipowners cannot forget that hesitation to turn from wooden ships to steel steamers once lost us the supremacy of the Atlantic. The building of motor ships will reduce the demand on fuel oil and their greater capacity will enable cargoes to be carried at lower rates with profit.—*The Nautical Gazette*, Sept. 25, 1920.

CENTRIFUGAL BOILER-FEED PUMPS.—The great advances in the construction of these pumps and their present advantages are pointed out.

Modern practice tends more and more to their use in place of the reciprocating type where large quantities of feed-water have to be dealt with. The points in their favor are: (1) Low initial cost; (2) low running cost; (3) small space occupied; (4) light weight and inexpensive foundations; (5) flexibility in operation; (6) smooth running; (7) they can be direct

coupled to turbine or high-speed motor. (J. White, *Electrician*, July 2, 1920.)—*The Technical Review*, Aug. 31, 1920.

AUTOGENOUS WELDING OF ALUMINIUM.—Although it is possible to weld two pieces of iron or platinum or copper together by means of a pointed flame it has not previously been possible to weld aluminium, on account of the formation of a thin layer of oxide on the surface, unless other metals, such as zinc and tin, are used as fluxes.

The Chemische Fabrik Griesheim-Elektron of Frankfort have patented (D. R. P. 222960 and 224284) a process whereby aluminium may be welded together with the assistance of a flux which dissolves the layer of oxide. The flux is aplied as a watery paste or in the form of a powder and is heated until it melts, shortly after which the aluminium melts and flows together. The pointed flame should contain an excess of hydrogen in order to have a reducing effect. With the application of any oxy-acetylene flame a mixture of 60 parts of potassium chloride, 12 parts of sodium chloride, and 4 parts of potassium sulphate proves very successful. The addition of small quantities of fluorine compounds assists the aluminium to flow together, with the result that a smoother joint is obtained. The flux may be used for fusing aluminium scraps together. (*Central-Zeitung für Optik und Mechanik*, July 10, 1920.)—*The Technical Review*, Sept. 14, 1920.

MISCELLANEOUS

OBREGON AS A PEACE DOVE.—The troops were there to awe the crowd when General Obregon was elected President of Mexico the other day. But the troops weren't needed, say the correspondents; since practically everybody was voting for the one-armed soldier there was nothing to fight about, and Mexico enjoyed the most peaceful day of balloting since the efficiently managed elections of the Diaz régime. The elevation of Mexico's best fighter to the Presidency in such an undisputed manner, strange as it may seem at first glance, is taken by many editorial observers as foreshadowing an era of peace. General Obregon, it is remembered, visited this country during the Great War and was taken on a tour of inspection of our camps and munition factories, and returned home an earnest advocate of peace between Mexico and the United States. In fact, this soldier has become an outspoken pacifist, saying: "I would rather teach the Mexican people the use of the tooth brush than to handle a gun. I would rather see them in schools than upon battlefields. I prefer any day a good electrician, machinist, carpenter, or farmer to a soldier." Mindful of Obregon's experience and present attitude, the *New York Tribune* calls his election "an omen of promise," and the *St. Louis Globe-Democrat* hopes, with many American dailies, that the General's success at the polls "will supply a starting-point for better relations between Mexico and the United States, as well as for a brighter future for the American people." Official Washington, according to a *New York Times* correspondent, "is inclined to be optimistic" over Obregon's election, although this, we are told, "does not mean that there is any immediate intention on the part of this government to recognize the government now in power in Mexico City."

"We want less war and more work," is Alvaro Obregon's motto for Mexico, according to a signed article he has written for the September *Mexican Review*, and from which the *New York Times* quotes these paragraphs in which the President-elect outlines his program:

"After satisfying our internal needs we will attack the foreign debt. The principal will be paid in full as it comes due, of course, if we can possibly pay; otherwise we will make arrangements for extension which will satisfy our creditors.

"When that is done we will talk about borrowing more money for the rehabilitation of our railroads and the building of our ports and other public works which have been allowed to go to pieces.

"Whatever money we borrow will be devoted to public works only. That guaranty I will personally give. Not one penny of borrowed money will be spent for the current expenses of the government.

"Our army will be cut in two. It will be reduced to one-half its present size, or 50,000 men, and will be well paid, clothed, equipped, and modernized. The 50,000 men retired will be aided to go to work on farms. We are now trying to discharge men in regions where work is plentiful and well paid. These men will remain in the reserve, subject to call.

"I shall propose to Congress that the generals be paid a lump sum in lieu or retirement pay that will enable them to buy homes or go into business and increase production. I shall try to reduce the number of clerks in government employ, too, and do away with sinecures.

"The country is at peace. . . . . There is to be no punishment for political offences, but those who have broken the law cannot hope to escape retribution merely because they have been Obregon's enemies. Magnanimity cannot be stretched to make a cloak for lawbreakers."

At the very best, we may expect that "even if Obregon should say the same things to us that Carranza once said, he will say them much more tactfully," observes the *New York Globe*. And, it adds, "the outlook is for a sensible modification of the Carranza policy which will be a much greater gain than courtesy." Obregon, the *New York Tribune* notes, is a civilian soldier who "has seen all of the seamy side of soldiering in Mexico," and "was the most competent military leader developed in the civil wars following Diaz's expulsion." He does not belong "to the exclusive *Científico* circle which ruled under Diaz," but is, we are told, "one of the larger Mexican group which prefers civilization to anarchy, economic progress to a succession of barren military revolutions." *The Tribune* continues:

"Obregon knows the United States much better than Carranza knew it. He realizes that Mexico's recovery must depend very largely on a restoration of amicable relations with this country. It will be easy to regain friendship, for the United States has no evil designs on Mexico, and merely demands reasonable respect for the rights and property of Americans under Mexican jurisdiction. If Obregon is willing to deal fairly with Washington, the friction which Carranza perpetuated and aggravated will soon disappear."

While General Obregon deserves his high military reputation, he does not, in the opinion of the *New York World*, "really belong to the professional soldier class, which has been at the bottom of so many of Mexico's political troubles." He shows "more of the solidarity of character that goes to the making of a temperate and intelligent ruler than any of the generals who have come to the fore in Mexico in the last 12 years." And, continues, *The World*, "in public utterances he has revealed a strong inclination to adhere to the policy of civilian control of the government, which Carranza, to his credit, sought to establish."

While optimistic talk like this is characteristic of much editorial comment, the other side is not entirely forgotten. The *Washington Post* says that one American interest in Mexico aided Obregon's election financially. The *Des Moines Register* warns us that whether this is so or not, nothing "could be more mischievous in effect upon our American continental relationships than the making of Mexico a playground of dollar intrigue. Real peace with Mexico cannot be founded upon it, nor a really stable Mexican Government."—*The Literary Digest*, Sept. 18, 1920.

THE HANDS-AROUND-THE-PACIFIC MOVEMENT.—The hands-around-the-Pacific Clubs are local organizations, affiliated with the Pan-Pacific Union, but governing themselves in each community. Many of these take the form of weekly luncheon clubs that entertain visitors and speakers from Pacific lands—the different clubs about the Pacific notifying one another of the proposed visits of distinguished men who have Pan-Pacific messages to deliver.

The Pan-Pacific Union is an organization representing governments of Pacific lands, and with which are affiliated chambers of commerce and kindred bodies, working for the advancement of Pacific states and communities, and a greater co-operation among and between the people of all races in Pacific lands.

The Pan-Pacific Union is incorporated with an International Board of Trustees, representing every race and nation of the Pacific.

The trustees may be added to or replaced by appointed representatives of the different countries co-operating in the Pan-Pacific Union. The following are the main objects set forth in the charter of the Pan-Pacific Union:

1. To call in conference delegates from all Pacific peoples for the purpose of discussing and furthering the interests common to Pacific nations.

2. To maintain in Hawaii and other Pacific lands bureaus of information and education concerning matters of interest to the people of the Pacific, and to disseminate to the world information of every kind of progress and opportunity in Pacific lands, and to promote the comfort and interests of all visitors.

3. To aid and assist those in all Pacific communities to better understand each other, and to work together for the furtherance of the best interests of the land of their adoption, and, through them, to spread abroad about the Pacific the friendly spirit of inter-racial co-operation.

4. To assist and to aid the different races in lands of the Pacific to co-operate in local fairs, to raise produce, and to create home-manufactured goods.

5. To own real estate, erect buildings needed for housing exhibits; provided and maintained by the respective local committees.

6. To maintain a Pan-Pacific Commercial Museum, and Art Gallery.

7. To create dioramas, gather exhibits, books and other Pan-Pacific material of educational or instructive value.

8. To promote and conduct a Pan-Pacific Exposition of the handicrafts of the Pacific peoples, of their works of art, and scenic dioramas of the most beautiful bits of Pacific lands, or illustrating great Pacific industries.

9. To establish and maintain a permanent college and "clearing house" of information (printed and otherwise) concerning the lands, commerce, peoples, and trade opportunities in countries of the Pacific, creating libraries of commercial knowledge, and training men in this commercial knowledge of Pacific lands.

10. To secure the co-operation and support of federal and state governments, chambers of commerce, city governments, and of individuals.

11. To enlist, for this work of publicity in behalf of Alaska, the territory of Hawaii, and of the Philippines, federal aid and financial support, as well as similar co-operation and support from all Pacific governments.

12. To bring all nations and peoples about the Pacific Ocean into closer friendly and commercial contact and relationship.

The Pan-Pacific Association is an organization allied with the Pan-Pacific Union, and in which membership is open to anyone who is in sympathy with Pan-Pacific endeavor, and the creation of a better knowledge in the world at large of the advantages Pacific lands have to offer.—*The Guam News Letter,* July, 1920.

BEHAVIOR OF THE CONCRETE SHIP "ARMISTICE" ON SERVICE.—Below is given a brief summary of the experience gained by Messrs. Leopold Walford (London) Ltd. during over 12 months' operations of the S.S. *Armistice,* the first British-built ferro-concrete steamship.

Constructed at Barrow-in-Furness from the designs of the Ferro-Concrete Ship Construction Co., Ltd., naval architects, and Messrs L. G. Mouchel & Partners, Ltd., civil engineers, the *Armistice* is owned by Messrs. Walford and has been run under their direction from her first trip in March, 1919, to the present date.

Messrs. Walford have expressed their views to Messrs. Mouchel as follow:

"Ever since March, 1919, the *Armistice* has been running like a clock, causing no trouble, disappointment, delay or difficulty. She has carried coal, minerals, and general cargo in all kinds of weather with every satisfaction. As general cargoes are relatively light and bulky, the greater cubical capacity of the vessel as compared with that of a steel vessel of equal dead-weight capacity has proved advantageous from the standpoint of freight-earning. Thus, on an early trip, the *Armistice* carried some 900 tons of oats, or about 200 tons more than could have been accommodated in a steel ship of equal dead-weight capacity.

"Having encountered severe gales and heavy seas, the ship has proven herself to be a thoroughly seaworthy boat. The captain, officers and crew speak in the highest terms of the ship, saying they could not wish for a more comfortable boat.

"Although the hull was not painted or treated with anti-fouling composition, it is perfectly clean after over 12 months' service. We do not wish to express any opinion as to the correctness or otherwise of the theories which have been put forward to account for the low frictional resistance of ferro-concrete hulls to passage through the water, being content with our practical experience that the *Armistice* does not require the consumption of more coal than would be wanted for a steel ship of equal capacity.

"On the score of upkeep, the *Armistice* shows well in comparison with steel ships, the daily cost per ton dead-weight having been only one-fifth the average cost for steel vessels working under similar conditions, the records of three typical steel vessels ranging from 2½ times, 3 times and 10 times those relating to the *Armistice*.

"Only two mishaps have occurred during the past year—on one occasion the ship grounded on a soft bottom and was got off without showing any trace of damage, and on another occasion the bow of a lighter punched a small hole in the stern deckhouse. The sides of this house are quite thin, and we are convinced that if the lighter had collided with the body of the hull no damage would have resulted.

"When the collision occurred, the *Armistice* was due to leave London the next morning; and as all ship repairers were then out on strike, the position was apparently serious; but in the end the damage was made good by a small quantity of cement mortar placed by the aid of boards inside and outside the deckhouse. This repair was effected by the staff of the boat, which was ready to sail at the appointed time. The readiness with which repairs can be carried out strikes us as a strong point in favor of concrete ships.

"Speaking generally, we are thoroughly satisfied with the *Armistice* in every way; and having regard to our experience with this vessel, we should not hesitate to use concrete ships in any of the services where we are now running steel vessels."—*The Marine Engineer and Naval Architect,* September, 1920.

NEW TYPE REINFORCED-CONCRETE SHIP.—A Copenhagen shipyard, Köbenhavns Flydedok, has completed a vessel to the design of the inventor, the late Mr. Bartels.

The total displacement is 3300 tons, the carrying capacity 1800 tons, the length 231 feet, the beam 36 feet 6 inches, and the draught when fully loaded 17 feet 6 inches. The ship, which is of the turret-deck type and provided with double bottom, is subdivided into five watertight compartments by bulkheads and doors of reinforced concrete. The total weight of the hull including 250 tons of steel reinforcement is 1120 tons. The concrete consists of one part of cement to two or two and one-half parts of conglomerates and has proved perfectly watertight under a head of 20 feet of water, although the walls of the ship are only three and one-half inches thick. It is engined with a triple-expansion engine of 500 horsepower and attained

a speed of 8.5 knots during the trial trip, which was considered entirely satisfactory to the owners and the Norwegian Veritas, who accepted it in the highest class for seagoing ships of the experimental type. It is fully equipped as a modern cargo boat with all necessary winches, etc., for rapid loading and unloading and is at present on a maiden voyage to England. (*Ingeniören*, June 12, 1920. 1 col.)—*The Technical Review*, Aug. 31, 1920.

THE DESIGN AND CONSTRUCTION OF MERCANTILE VESSELS CONSIDERED IN THE LIGHT OF RECENT WAR EXPERIENCE.—The author presents some information obtained from investigations carried out at the request of the Board of Trade into the circumstances attending the damage or loss of mined or torpedoed vessels, with a view to determining whether the experience so gained suggested modifications of design or details which would conduce to greater safety of life at sea.

One of the conclusions he reaches is that the permeability figures suggested by the 1914 Bulkhead Committee report are reasonable. To make a vessel reasonably safe against attack from a single torpedo or after striking a mine, the ship should be capable of remaining afloat with any two holds open to the sea, and the minimum length of hold should not be less than 40 or 45 feet.

To indicate the behavior of vessels subsequent to being torpedoed or mined, under the conditions prevailing at the time, details are given of 19 representative cases and general conclusions from these data are drawn. Among these conclusions are the following: (1) Many ships after damage remained afloat and reached port; accordingly, their watertight subdivision was sufficient under the actual conditions as to lading. (2) Had some of the large vessels sunk been subdivided according to the recommendations of the 1914 Bulkhead Committee, they would have survived the damage received. (3) Some of the contributory reasons for large vessels being sunk by one mine or torpedo were as follows: (*a*) watertight doors were open which became inaccessible after the casualty. (*b*) Below the bulkhead deck, sidelights were open. (*c*) Suction pipes were often fractured in the damaged compartments, thus putting other spaces in communication with the sea. (*d*) Bulkheads and tunnels were leaky. (*e*) Pipes—such as voice pipes and pump suctions from hotwell—were carried through bulkheads low down in the holds without valves at the bulkheads. (*f*) Air-escape pipes and test-pipes were sometimes carried only a short distance above the tank top—some with and some without stopcocks. (4) Nothing has occurred which throws doubt upon the adequacy of the scantlings for bulkheads recommended by the Bulkhead Committee.

The paper concludes with some observations on the subject of transverse subdivison. (Professor J. J. Welch, B. Sc., paper read before the Institution of Naval Architects, July 6, 1920.)—*The Technical Review*, Aug. 31, 1920.

CURRENT NAVAL AND PROFESSIONAL PAPERS *

Naval Architecture in Aeronautics (Hunsaker). *The Aeronautical Journal*, July, 1920.

The High Voltage Corona in Air. *Proceedings of the American Philosophical Society*, No. 4, 1920.

Fuel Oil for Marine Purposes. *The Marine Engineer and Naval Architect*, September, 1920.

Rate Setting Works in Shipyards. *Engineering and Industrial Management*, Aug. 26, 1920.

Developing the Engineering Mind. *Engineering and Industrial Management*, Aug. 26, 1920.

Japan and the Japanese—California Problem. Three Points of View. *The New York Times Current History Magazine*, October, 1920.

* NOTE.—All of these articles are kept on file in Institute office and will be mailed for perusal and return to any member upon request.

NOTES ON INTERNATIONAL AFFAIRS

FROM SEPTEMBER 10 TO OCTOBER 10

PREPARED BY

PROFESSOR ALLAN WESTCOTT, U. S. Naval Academy

POLAND AND RUSSIA

RUSSO-POLISH ARMISTICE SIGNED.—On October 5 the Russian and Polish delegates at Riga signed an armistice and peace preliminaries providing that fighting should cease on October 8. Early despatches stated that the terms were practically those laid down by Poland. The Poles defined a boundary on ethnographic lines, beginning east of Dvinsk and following the German military line of 1915 to the Rumanian frontier. Poland, it was stated, secured a corridor completely cutting off Lithuania from Russia.

POLISH-LITHUANIAN AGREEMENT.—At the same time as the Riga agreement, the Poles and Lithuanians declared an armistice, awaiting the settlement of their dispute by a commission from the League of Nations. This commission, which includes the Spanish ambassador to France and the Japanese under secretary of foreign affairs, reached Lithuania on October 5, and at its instance the armistice was negotiated.

LEAGUE OF NATIONS

ACTS IN ALAND ISLANDS AND POLISH-LITHUANIAN DISPUTES.—The ninth session of the League of Nations Council was held in Paris on September 16-20, Leon Bourgeois presiding. In his opening speech M. Bourgeois asserted that the submission of the Lithuanian and the Aland Islands disputes to the Council was the best augury for the future of the League.

The action taken regarding the Aland Islands, claimed by both Sweden and Finland, was the appointment of three commissioners to conduct an investigation on the scene. The islands, formerly controlled by Russia, are linked to Finland by a continuous chain of islands and by ice for four months in the year; but the population is said to be nine-tenths Swedish and favorable to Swedish control. The archipelago has considerable strategic importance from a naval standpoint, guarding the entrance to the Gulf of Bothnia.

Agreement to submit the Polish-Lithuanian dispute to a commission appointed by the Council (the action of which appears elsewhere in the notes) was reached by the Polish representative, Ignace Paderewski, and the Lithuanian Foreign Minister Woldemar.

MEMBERSHIP OF LEAGUE.—Rumania deposited ratifications of the Treaty of Versailles on September 14, making a total of 26 signatories that have deposited their ratifications at Paris.

Washington, Sept. 30.—Supplementary data regarding membership in the League of Nations show that in addition to the states already announced as members of the League 13 states not mentioned in the annex to the covenant have submitted requests for admission. These states and the dates of their request are:

Esthonia	Apr. 10, '20	San Marino	Apr. 23, '19
Finland	May 8, '20	Ukraine	Feb. 25, '20
Georgia	May 21, '10	Costa Rica	Sept. 14, '20
Iceland	July 2, '19	Armenia	May 13, '20
Letvia	May 14, '20	Leichtenstein	July 15, '20
Luxemburg	Feb. 23, '20	Bulgaria (unofficial)	Sept. 2, '20
Monaco	May 3, '20		

In connection with the list of members as already published, the information received by the State Department shows the following dates of their accession to the League:

Original members	Date of accession	Original members	Date of accession
*Great Britain	Jan. 10, '20	Liberia	June 30, '20
France	Jan. 10, '20	Peru	Jan. 10, '20
Italy	Jan. 10, '20	Poland	Jan. 10, '20
Japan	Jan. 10, '20	Portugal	Apr. 8, '20
Belgium	Jan. 10, '20	Kingdom of the Serbs, Croats and Slovenes (Jugoslavia)	Feb. 10, '20
Bolivia	Jan. 10, '20	Rumania	Sept. 14, '20
Brazil	Jan. 10, '20	Siam	Jan. 10, '20
†China	July 16, '20	Czechoslovakia	Jan. 10, '20
Cuba	Mar. 8, '20	Uruguay	Jan. 10, '20
Greece	Mar. 30, '20		
Guatemala	Jan. 10, '20		
Haiti	June 30, '20		

INVITED MEMBERS

Argentina	July 18, '20	Persia	Nov. 21, '19
Chile	Nov. 4, '19	Salvador	Mar. 10, '20
Colombia	Feb. 16, '20	Spain	Jan. 20, '20
Denmark	Mar. 8, '20	Sweden	Mar. 9, '20
Netherlands	Mar. 9, '20	Switzerland	Mar. 8, '20
Norway	Mar. 5, '20	Venezuela	Mar. 3, '20
Paraguay	Dec. 26, '19		

*Including colonies. †By ratification of Austrian treaty.

Aside from Germany, Austria and Turkey, who are debarred provisionally under the Peace Treaty, the only nations who have not joined the League or made application for admittance are the United States, Russia and Mexico. The two latter because of their disturbed internal conditions have not been invited to become members.—*N. Y. Times*, Oct. 1, 1920.

LLOYD GEORGE ON THE LEAGUE.—In an interview for the *Lloyd George Liberal Magazine* of October 7, the British Premier spoke as follows of the League of Nations:

"We shall not have an effective League of Nations until all the nations come in. You must have America within the League of Nations, and also Germany. Germany should be allowed to come in once she proves that

she will respect her treaty obligations. I believe that she will, but now she is on her trial. If she gives proof of good faith Germany will be welcomed within the League.

"I believe, too, that America will come in after the presidential election. When those two events happen the League of Nations will become an effective instrument. At present it is only a league of allies."

INTERNATIONAL CONFERENCES

FINANCIAL CONGRESS AT BRUSSELS.—The International Financial Congress at Brussels, presided over by President Gustave Ador of Switzerland, closed on October 7 after 10 days' session. The work of the conference was handicapped by the failure of the Allied Powers to reach a definite arrangement with Germany regarding reparations. The chief recommendation of the conference was for an international credit system, the details to be arranged by a commission appointed by the League of Nations Council, through which nations could negotiate loans and deposit securities therefor without calling upon other individual powers. The conference report pointed out that three out of every four nations represented at the conference faced deficits for the current year, and eleven out of every twelve countries of Europe.

COMMUNICATIONS CONFERENCE AT WASHINGTON.—The five chief Allied and Associated Powers opened a Communications Conference at Washington on October 8, preliminary to a general international conference on communications to be arranged for later. At this conference the American delegates are stated to be chiefly interested in the disposition of former German cables, and free and uncensored use of cables throughout the world at fair charges. It is estimated that at present Great Britain controls about 150,000 miles of cable, or more than that of all other nations combined. The United States controls about 50,000 miles.

Of greater significance, however, according to officials, than the cable mileage possessed by other nations, is that the United States obtain direct information, free from censorship or the control exercised by other nations over cables passing through foreign territory.

The great proportion of cable dispatches reaching the United States, it is estimated in the Government survey, must pass through the control of British, French or Japanese cable lines. Practically all cablegrams from Europe pass through Paris or London. Into London flow the channels of information from Northern Europe and the Mediterranean; into Paris, lines from Germany, Poland, the Baltic States and Africa. Much of the traffic from Paris also goes through London.

It is to remedy this situation and to arrive, if possible, at arrangements whereby cable messages in times of peace may be as free from control and censorship as mail matter under the conventions of the International Postal Union, officials said to-day, that American representatives to the conference are directing their efforts.

The problem of the disposition of the German cables promises to be the most difficult, if not the most vexatious, at the conference. This country is as greatly interested in the two German lines from New York to Emden as it is in the lines radiating from the Island of Yap to China and other Far Eastern points. There is another German line from Monrovia, Liberia, to Brazil.

This Government would not hesitate to take the German lines over if that should be possible, but it is intimated rather that the American delegation will urge that American interests be permitted to purchase some of those lines. Ownership of some of the German cables by America or American interests, it is declared, would greatly assist toward the realization of the general objective.

The Postal Telegraph and Cable Company had a forty-year contract with one of the German cables from New York to Emden, and it is now desired by American interests to purchase one or both of the New York-Emden lines.

It has not been decided where the general conference, to which all nations will send delegates, shall be held. It is the expectation of officials here that Washington will be chosen by the preliminary conference, but Paris is understood to be making bids. The International Communications Conference called to meet in 1914 was to have been held in Paris, but was called off on account of the war.—*N. Y. Times,* Oct. 5, 1920.

GREAT BRITAIN

VARIED PROPOSALS FOR IRELAND.—In the midst of a reign of terror in Ireland, British statesmen came forward with various plans for settlement. Ex-premier Asquith in Parliament refused to be alarmed at the idea of an Irish republic and proposed to grant Ireland an "unconditional dominion status," though he refused to go into details on the question of control of military affairs and finance. The substance of Viscount Grey's proposals in the London press were that Ireland should be allowed to draw up her own scheme of government on a dominion basis, reserving to Great Britain only control over foreign policy and military forces. The Grey plan was favored by Lord Robert Cecil, who believed the Irish should be called on to assume the responsibility of settling their own affairs.

President de Valera of the "Irish republic" in a Washington interview rejected the Grey proposal, declaring that the Irish-British problem could be solved only by a treaty "on the basis of a guarantee of Ireland's independence on the one hand, and, if the British need it, a guarantee of British security on the other by some international instrument."

Lloyd George in interviews objected to the plan of an Irish dominion, declaring that, aside from the question of military affairs, Great Britain would not consent to Ireland's controlling her own finances and dodging the burden of taxation resulting from the war.

Carnarvon, Wales, October 9.—Premier Lloyd George in a fighting speech to his Welsh constituents to-day, which was intended also for the world at large, declared that the government intended to restore order in Ireland by "methods however stern" and proceed with its home-rule bill.

The Prime Minister turned down dominion home rule, protesting against the suggestions that the government should go farther than did Gladstone or Asquith, "not because Ireland needs it, not because it is fair to the United Kingdom, but because crime has been successful."

FRANCE

MILLERAND ELECTED PRESIDENT.—Paul Deschanel, President of France, resigned on September 16, on account of ill health. His successor is former Premier Millerand, who was elected by the French chambers meeting as

a National Assembly on September 25. The new president selected M. George Leygues, Minister of Marine in Clemenceau's War Cabinet, for the office of premier, at the head of a ministry otherwise unchanged. Premier Leygues has been six times Minister of State and is an aggressive member of the Republican group of the left.

The Millerand-Leygues Government after coming into office adopted the policy of preventing the rift apparently opening in Anglo-French relations, owing for one reason to French unwillingness to attend the Geneva Conference. The new government is likely to meet stiff opposition from the followers of M. Briand, but will have smooth sailing until the reassembly of parliament in November.

ITALY

GOVERNMENT SETTLES LABOR PROBLEM.—During the week of September 16 Premier Giolitti stepped in to attempt a solution of the struggle, verging on revolution, between labor and capital in Italy. Following a series of conferences, the employers on September 18 submitted to the government proposal, which in effect provided for increases of pay retroactive from July 15, and for the appointment of a commission to arrange for "syndical control" of industries. This plan will give labor, as well as the government, a share in the management of industrial establishments. The agreement was accepted by workers in Northern Italy by a vote of 132,000 to 45,000.

Following the settlement, the Metallurgic Union issued orders to workers to evacuate factories occupied by them and after a week's holiday to resume work on October 4.

SPLIT AMONG ITALIAN SOCIALISTS.—On October 2 the Socialist executive body in Italy, meeting at Milan, decided by a vote of 7 to 5 to accept the 21 articles of the Bolshevist creed as drawn up by the second congress of the Third International at Moscow. It is thought that this step will cause a breach between radicals and moderates of the Socialist party in Italy. As indicated by the vote, the former wing now controls the party executive and its parliamentary activities.

BALKAN STATES

BALKAN "BLOC" ESTABLISHED.—A defensive agreement between Jugoslavia and Czechoslovakia was signed on August 16. Following this treaty, Rumania also entered the so-called "Little Entente," proposing at the same time that, to make it really effective and dominant in Central and Southeastern Europe, Poland, Greece and Bulgaria should be included. An alliance of all the Balkan states would be in purpose a protective alliance against Russia and Germany, and it is thought would not be objectionable to France, Italy, and other of the western powers.

An official declaration of the parties to the agreement, issued in August, states that its object is primarily protection against the ambitions of Magyars in Hungary; that economic arrangements have been made with Austria; and that "the united power of Czechoslovakia, Jugoslavia, and Rumania

is so considerable that no state in Central or Eastern Europe would venture to attack this alliance."

UNITED STATES AND JAPAN

PROPOSED CALIFORNIA LAND LAW.—The provisions of the proposed California land law, which is directed against Japanese property holders, and which is to be submitted to the voters for ratification in November, are summarized as follows:

It permits the acquisition and transfer of real property by aliens eligible to citizenship to the same extent as by citizens, except as otherwise provided by law. It further permits other aliens and the companies, associations and corporations in which they hold majority interests to acquire and transfer real property only as prescribed by treaty and prohibits the appointment of such ineligible aliens as guardians of the estates of minors consisting wholly or partially of real property or shares in such corporations. It also provides for escheats in certain cases, and requires reports of property holdings to facilitate the enforcement of the act. It prescribes penalties and repeals conflicting acts.

Advocates of the measure declare that it merely parallels the Japanese law forbidding ownership of agricultural land in Japan. The Japanese contend, however, that it discriminates between Japanese and other aliens.

JOINT COMMISSION UNLIKELY.—Washington, September 27.—Administration officials continue to decline to discuss for publication any of the phases of the negotiations with Japan growing out of the proposed anti-Japanese land law in California, but the impression has gone out that a proposal from Tokio that the question be referred to a joint commission for solution would be unacceptable.

The conversations regarding the California law which have been going on between Ambassador Shidehara of Japan and State Department officials are continuing, and, so far as has been learned, the proposal for a joint commission has not been formally communicated to Washington by the Japanese government.

What progress, if any, has been made in the negotiations has not been disclosed. The attitude of the State Department is described as one calculated to prevent the development of a feeling of alarm in the United States that might approach even approximately that which appears to be growing in Japan.—*Baltimore American*, Sept. 28, 1920.

JAPANESES CONTROL IN ASIA.—In the *N. Y. Times Current History* for October, Morgan Young of the *Japan Chronicle* writes as follows of the situation in Japan:

The Military Party, which still runs the Japanese Government, probably desires war less than anybody, but it believes in the rattling of the saber, and will rattle it as readily on a point of national dignity as on any other.

But while the talk of war with America is fed by the California debate, its object is rather to get enormous defence estimates passed and to convince America that Japan's " special position " in Eastern Asia is too thorny for serious dispute. American capital is welcome in Eastern Asia, but it must be under the ægis of Japanese militarism.

This brings us to Eastern Asia as a field for Japanese emigration. Japanese themselves prefer South America, but the government does very little to encourage what only means a loss of subjects, and the Japanese so unfailingly become disliked where they go in large numbers that such colonies are only a vexation. In Korea and South Manchuria, as well as in Eastern Siberia, there is still virgin soil of the best quality. It is attractive enough

for Japanese settlers (though its climatic rigors are far less agreeable than the softness of California), but the trouble begins when it comes to marketing the produce, for though the land is far from full the native cultivator is an invincible competitor. The Japanese feels no more gratitude to the native competitor for his industry than the Californian does to the Japanese, but he cannot turn him out, and consequently Japanese immigration is but slow. Whether it will be any faster in the newly opened regions of Siberia remains to be seen. However, though in ten years no more people have gone to Korea than can be replaced by natural increase in one year in Japan, the Japanese population on the mainland increases, and remains intensely Japanese. It is the militarist ideal, and even a cultural ideal, to have a great Japanese Empire in Eastern Asia, of which the islands constituting Japan proper shall be only an outpost.

Popular education among such a biddable people as the Japanese has been able to make a religion of loyalty, but it cannot make people emigrate to places that they do not like, even for the sake of empire. The Japanese showed perfect willingness to die in Manchuria. They have yet to show a willingness to live there. But with the strategic and economic control of all Eastern Asia in her hands, and the direction of the spare American capital ready for investment in Asia, the Japanese Government may be able to make Manchuria, Eastern Mongolia, Eastern Siberia and Korea sufficiently attractive to absorb the whole natural overflow of Japan.

MEXICO

CALDERON LEAVES WASHINGTON.—Oct. 5.—Unable to accomplish his mission to the United States, that of settling all differences between this country and Mexico, Fernando Iglesias Calderon, Mexican High Commissioner to Washington, has resigned and plans to return to Mexico City within a week.

At the embassy to-day it was said that the High Commissioner had been given plenipotentiary powers in order quickly to settle all claims against Mexico by citizens of the United States, including the oil question and all other questions that have caused strained relations between the two countries. At the State Department, however, it was stated that the department had not been notified that the commissioner had any such full powers. It was added that the official acts preliminary to recognition of the new Mexican Government by the United States must be performed in Mexico and that government must demonstrate its willingness and ability to fulfil its international obligations.—*N. Y. Times,* Oct. 6, 1920.

PRESIDENT OBREGON WELCOMED ON BORDER.—President-elect Obregon of Mexico crossed the border to El Paso on October 7, spoke at a lunch given by the Rotary Club, and was given a cordial welcome by Americans of the border states. Among those expected to be in El Paso during his visit were the governors of Arizona, New Mexico, and Texas, and also the governors of Chihuahua and Sonora in Mexico.

REVIEW OF BOOKS

"Boys' Book of Sea Fights." By Chelsea Curtis Frazer. Illustrated. 320 pages. (Published by Thomas Y. Crowell Company.)

An interesting, non-technical account of some of the important sea fights and fighters of the United States, England, and France, from the exploits of Sir Francis Drake to the Battle of Jutland.

The book is as well suited to the older reader, who does not desire a technical study of naval history, as to the boy. In fact the comment of a boy of eleven was, "It wouldn't be a very interesting book if it weren't on so interesting a subject."

A few inaccuracies are noted, particularly in the chapter on the "Fight off the Falklands," in which the data on ships engaged are all wrong, except as to names. The plates show only the locality of the engagements and nothing of the maneuvers of the vessels engaged.

The subjects of chapters are:

I. Sir Francis Drake.
II. Marshal Anne-Hilarion de Tourville.
III. Commodore John Paul Jones.
IV. Lord Horatio Nelson.
V. The Burning of the *Philadelphia*.
VI. Perry's Victory on Lake Erie.
VII. The *Constitution* and the *Guerriere*.
VIII. The Ship that Strangely Disappeared.
IX. The *Monitor* and the *Merrimac*.
X. Admiral David Farragut.
XI. Dewey at Manila Bay.
XII. The Battle of Santiago Harbor.
XIII. The Running Fight Off the Falklands.
XIV. The Battle Off Jutland Bank.

B. C. A.

More members, both regular and associate, are desired. Any increase in membership invariably means a larger number of articles submitted, and consequently an improvement in the PROCEEDINGS.

You are requested to send or give the attached slip to some one eligible for membership, urging him to join.

By direction of the Board of Control,

H. K. HEWITT,
Secretary-Treasurer.

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Secretary and Treasurer,
U. S. Naval Institute,
Annapolis, Md.

Dear Sir:

Please enroll my name as a {*subscriber* / *regular member* / *associate member*} *of the U. S. Naval Institute from*..................

Very truly yours,

For eligibility as to membership and for difference between members and subscribers see opposite page (Constitution).

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NOTICE

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It is now in its forty-seventh year of existence. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers upon subjects of interest to the naval profession, as well as by personal support.

On the subject of membership the Constitution reads as follows:

ARTICLE VII

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control. To be declared elected, they must receive the affirmative vote of three-quarters of the members represented at regular or stated meetings, either in person or by proxy.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control. The Board of Control will at each regular meeting ballot on the nominations submitted for election, and nominees receiving a majority of the votes of the board membership shall be considered elected to membership in the United States Naval Institute."

Sec. 8. The annual dues for regular and associate members shall be three dollars, all of which shall be for a year's subscription to the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, payable upon joining the Institute, and upon the first day of each succeeding January. The fee for life membership shall be forty dollars, but if any regular or associate member has paid his dues for the year in which he wishes to be transferred to life membership, or has paid his dues for any future year or years, the amount so paid shall be deducted from the fee for life membership.

ARTICLE X

Sec. 2. One copy of the PROCEEDINGS, when published, shall be furnished to each regular and associate member (in return for dues paid), to each life member (in return for life membership fee paid), to honorary members, to each corresponding society of the Institute, and to such libraries and periodicals as may be determined upon by the Board of Control.

The PROCEEDINGS are published monthly; subscription for non-members, \$3.50; enlisted men, U. S. Navy, \$3.00. Single copies, by purchase, 30 cents; issues preceding January, 1920, 50 cents.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ARTICLE, 1921

A prize of two hundred dollars, with a gold medal and a life-membership (unless the author is already a life member) in the Institute, is offered by the Naval Institute for the best original article on any subject pertaining to the naval profession published in the PROCEEDINGS during the current year. The prize will be in addition to the author's compensation paid upon publication of the article.

On the opposite page are given suggested topics. Articles are not limited to these topics and no additional weight will be given an article in awarding the prize because it is written on one of these suggested topics over one written on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. All original articles published in the PROCEEDINGS during 1920 shall be eligible for consideration for the prize.

2. No article received after October 1 will be available for publication in 1920. Articles received subsequent to October 1, if accepted, will be published as soon as practicable thereafter.

3. If, in the opinion of the Board of Control, the best article published during 1920 is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention," or such other distinction as the Board may decide.

4. In case one or more articles receive "Honorable Mention," the writer thereof will receive a minimum prize of seventy-five dollars and a life-membership (unless the author is already a life member) in the Institute, the actual amounts of the awards to be decided by the Board of Control in each case.

5. The method adopted by the Board of Control in selecting the Prize Essay is as follows:

(a) Prior to the January meeting of the Board of Control each member will submit to the Secretary and Treasurer a list of the articles published during the year which, in the opinion of that member, are worthy of consideration for prize. From this a summarized list will be prepared giving titles, names of authors, and number of original lists on which each article appeared.

(b) At the January meeting of the Board of Control this summary will, by discussion, be narrowed down to a second list of not more than ten articles.

(c) Prior to the February meeting of the Board of Control, each member will submit his choice of five articles from the list of ten. These will be summarized as before.

(d) At the February meeting of the Board of Control this final summary will be considered. The Board will then decide by vote which articles shall finally be considered for prize and shall then proceed to determine the relative order of merit.

6. It is requested that all articles be submitted typewritten and in duplicate; articles submitted written in longhand and in single copy will, however, receive equal consideration.

7. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

H. K. HEWITT,
Commander, U. S. N., Secretary and Treasurer.

TOPICS FOR ARTICLES

Suggested by Request of the Board of Control

"Rebuilding the Navy's Enlisted Personnel, and Reestablishing Its Morale and Spirit After the Serious Slump Caused by too Rapid Demobilization and High Wages in Civil Life."
"The Human Element in the Administration of Discipline."
"A Demobilization Programme for the Future."
"The Mission of the Naval Academy in the Molding of Character."
"Health of Personnel in Relation to Morale."
"Physical Factors in Efficiency."
"The Naval Officer and the Civilian."
"Naval Bases, Their Location, Number and Equipment."
"Military Character."
"The Ability to Handle Men a Necessary Element in the Equipment of a Naval Officer."
"The Relation of Naval Communications to Naval Strategy."
"The Relation of Naval Communications to Naval Tactics."
"The Training of Communication Officers."
"The Organization of a Naval Communication Service."
"The Naval Policy of the United States."
"A Review of the Battle of Jutland with Lessons to be Learned Therefrom."
"Modification in the Design and Armament of Ships to Meet the New Conditions of Aerial and Subsurface Attack."
"Coordination of Surface, Subsurface and Aerial Craft in Naval Warfare."
"Our New Merchant Marine."
"Submarine Warfare, Its History and Possible Development."
"Escort and Defense of Oversea Military Expeditions."
"A Proposed Building Programme for the U. S. Navy, Including an Efficiency Air Service."
"Naval Organization from the Viewpoint of Liaison in Peace and War Between the Navy and the Nation."
"The Ship's Company—Its Training, Discipline and Contentment."
"The Principles of Leadership of Naval Personnel."
"Morale Building."
"The Value of Facility in Exposition—Verbal and Written—for Naval Officers."
"Discipline as Affected by the Human Relation."
"The Value of Pep."
"Navy Spirit—Its Value to the Service and to the Country."
"The Influence of the Term of Enlistment on the Efficiency of the Service."
"The Principles upon which Should be Founded the Freedom of Neutral Shipping on the High Seas."
"The Fighting Fleet of the Future."
"The Future of the Naval Officer's Profession."
"The Navy: Its Past, Present and Future."
"The Navy in Battle: Operations of Air, Surface and Underwater Craft."
"Shall I Remain in the Navy?"
"Psychology and Naval Efficiency."
"The Naval Policy of the United States in the Light of the Peace Treaty."
"Scope of Naval Industrial Activity and the Navy's Relation to Shore Industry."
"The Pacific Theater."
"Was Germany's Coast Impregnable?"
"Future Development of the Naval Shore Establishment."
"America as a Maritime Nation."
"Arguments for and against the Restriction of the Manufacure of Munitions to Government Owned Factories."
"The Present Rule of Neutrality regarding Contraband and Blockade—Is it Justifiable in Ethics or in Expediency?"
"The United States Navy and the League of Nations."
"Is a League of Nations *Navy* Desirable?"
"The Adaptability of Oil Engines to all Classes of War Vessels."
"The Place of Mines in Future Naval Warfare and the Rules under which Their Use Should be Allowed."
"The Use and Abuse of the Doctrine of Continuous Voyage."
"The Question of the Future Use of Submarines."

LIST OF PRIZE ESSAYS

"WHAT THE NAVY HAS BEEN THINKING ABOUT"

1879

Naval Education. Prize Essay, 1879. By Lieut. Commander A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut. Commander C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881

The Type of (I) Armored Vessel, (II) Cruiser Best Suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882

Our Merchant Marine: The Causes of Its Decline and the Means to Be Taken for Its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut. Commander F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883

How May the Sphere of Usefulness of Naval Officers Be Extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

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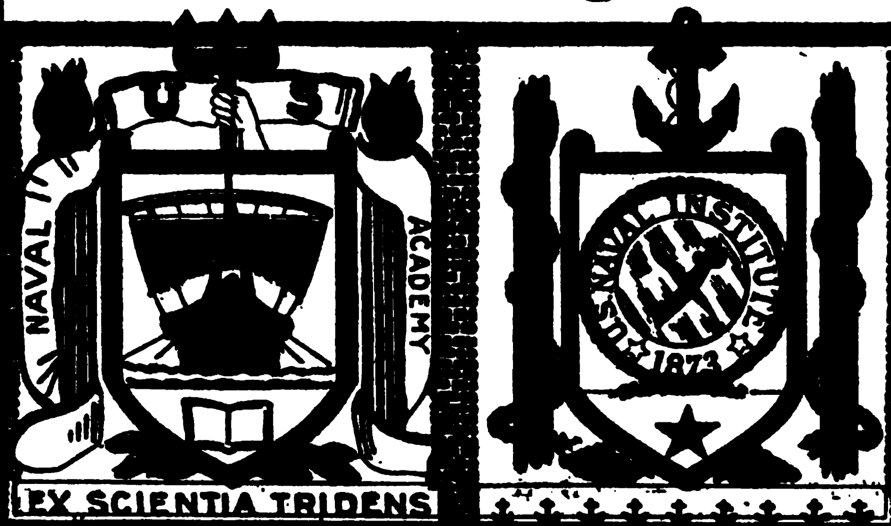

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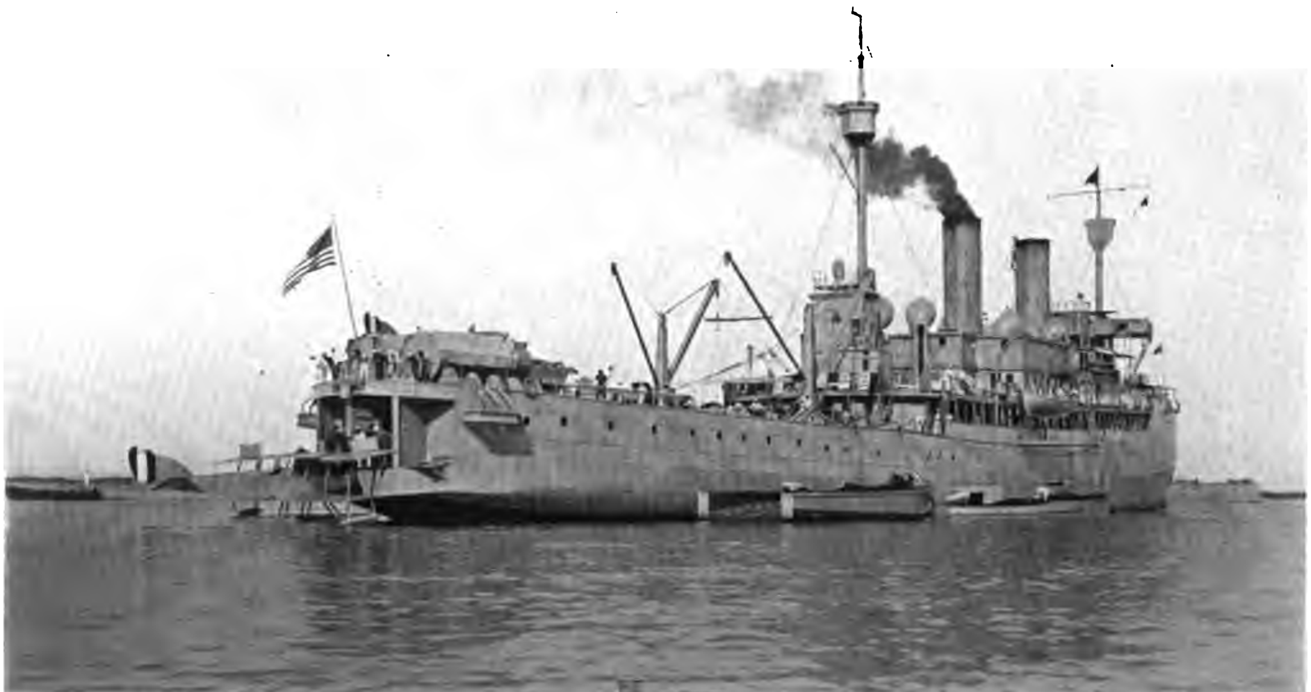

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THE ELEMENTS OF LEADERSHIP[1]

By CAPTAIN DUDLEY W. KNOX, U. S. Navy

In its broadest sense Leadership encompasses the entire profession of the officer; and is virtually synonymous with officership. But we are not here concerned with those aspects of the subject pertaining to "higher command." In a more restricted, and probably a better technical sense, Leadership relates primarily to the *handling of subordinates;* which is the paramount function of officers. Even in the multifarious duties connected with material, the officer's primary rôle is the handling of men who manipulate the material.

The practice of any art is facilitated greatly by knowledge of and skill in related arts. The dentist must know something of medicine and surgery; the seaman and the aviator require familiarity with meteorology, etc. So it is with Leadership. The leader of men is handicapped seriously without a good working knowledge of such arts as organization and administration. This is a necessary foundation for Leadership. Moreover, proficiency in leading men, as in all other forms of human endeavor, is immensely furthered by a knowledge of the governing principles. Once principles are mastered, sound practice follows inevitably. Ignorance of principles limits and retards tremendously the development of proficiency; it compels the practical man to grope

[1] Lecture delivered at the Staff College, Pacific Destroyer Force, Rear Admiral H. A. Wiley, Commanding; August, 1920.

and flounder; to learn only through laboriously repeated experience, which he can analyse and profit by only with much difficulty and serious waste of time. Principles serve as a compass—a practical means to point the direct course.

For these reasons it is considered that the most practical and helpful method of treating our subject is primarily to formulate principles; and then to give such consideration to their application as time will permit.

PRINCIPLE I. A LEADER MUST EXERCISE CONTROL OVER HIS SUBORDINATES

This is the basic principle; the need for which is too well understood to require argument. What concerns us here is how to get this control. In the navy, law and regulations provide ample authority for duly constituted leaders. But unless such authority is actually exercised, it is valueless. How often have we seen young officers and petty officers virtually impotent because they knew not how to exercise the authority which was theirs? Occasionally even old officers are seen who have failed to develop in themselves sufficient capacity for Leadership, and hence are unable to use their authority effectively and to control properly their subordinates.

To a great extent control over men is influenced by the leader's "military character," which will be discussed later. Organization is another important element, more especially as the number of men increases. But the basis of control is *discipline*. Subordinates must obey if the fundamental purposes of a military organization are to be accomplished.

Punishment is usually associated prominently with discipline. It is more logical to link it with indiscipline. The need for excessive punishment, in degree or frequency, is certain evidence of bad discipline; which can be corrected best, not by punishment as a primary agency, but by good morale established by a type of Leadership in which punishment plays a minor rôle.

On quiescent occasions the specter of punishment, however sorry a substitute it may be for good morale, may be adequate to obtain satisfactory obedience. But in battle, or other emergency—such as "man overboard," fire, collision, etc.—the mere ability to obtain obedience, through either fear or good will, is not

sufficient; at such times of crucial test, obedience must be prompt to an extreme, *virtually instinctive,* if panic, failure, loss of life, or defeat, are to be averted and success achieved.

Instinctive obedience in crises cannot be obtained without enlisting the aid of *habit;* because under unusual mental tension the average mind escapes the ordinary rule of the will, and *habits* alone dictate conduct. However important the function of drills in promoting mechanical efficiency, such effect is of less value than of instilling a *habit* of *obedience.* The officer who fails to exploit this aspect of drills; who permits men to obey leisurely, to answer back, to be slovenly in bearing, etc., may possibly accomplish something towards improvement in mechanical manipulation, but the net result will be positively harmful, owing to the promotion of a habit of indiscipline—a habit which will cost lives in emergencies.

The need for instinctive obedience in order to save life and ships, and to win battles, is the great impelling reason for the ceremonies and conventions of military life; and for general "smartness" of every kind. These tend constantly to create a *habit* of subordination and obedience to proper authority. It may appear to be a stretch of imagination to contend that strict observance of the salute and other minor formalities will play an important part in meeting major emergencies successfully, yet it is a fact; because the habits thus formed by repeated daily observance promote in great measure that control without which disorganization and failure readily occur under stress.

It is said that until the first gas attack the Canadians of all ranks were impatient of and inclined to ridicule these seemingly petty conventions. Their bitter experience then, when a great number of lives were lost unnecessarily through the breakdown of military control, convinced them of the vital importance of tautness in minor military etiquette. Thereafter the Canadians made a fetish of such things and soon became a crack fighting army. The earnestness and thoroughness with which the quickly created American Expeditionary Forces observed the salute and other formalities undoubtedly contributed more than any other single factor in their early readiness for active service, and their excellent showing in battle. There can be little doubt of this fact when we contrast the superb performances of American troops in Europe, with the many disgraceful incidents in American history

of which troops were guilty who scorned the apparent trivialities. When the Bolsheviki abolished the salute, the troops left the trenches and sold their artillery. It was only after the fallacy of their theories had been proved that the Bolsheviki resorted to the harshest discipline in Europe, and began to be successful.

The hand salute, the "sir," the cheery "aye, aye," standing at attention, piping the side, parading the guard, gun salutes, etc., are all marks of respect, subordination and courtesy, of the highest utility in promoting control through habit. It is not a trivial duty that every officer shall himself be punctilious in these matters; nor that he should take sufficient pains to keep others up to the mark. In view of the regulations and well established custom in these conventions, their neglect constitutes an act of indiscipline; which if repeated often will surely lower our cohesion and efficiency in emergencies, through the strong psychological influence of habit. To blink at these things is to train falsely.

On the other hand, there is danger in overdoing etiquette, ceremony and smartness, and of defeating their own ends by reaction. An overdose, psychological or physical, is frequently more harmful than an underdose. It is just as essential *not* to keep men standing at attention without sufficient reason, as it is to do so when proper occasion demands. Subordinates should not be expected, nor required, to salute when engaged in occupations requiring their concentrated attention; nor under unusual circumstances where its omission does not constitute obvious neglect. Tact and a sense of appropriateness are required. When the occasion calls for etiquette and ceremony, habitual and punctilious smartness should be insisted upon; but when they are out of place, informality and relaxation should be provided for just as carefully. The preservation of this balance is a mark of good officership.

The stabilizing influence of habit facilitates greatly the needful control over men's volition. Discipline, built up by habit, furnishes a strong impulse to obey orders from higher authority, when excitement in any form tends to undermine the mental control which men normally exert over their individual actions.

Habit serves the purposes of Leadership control in another way also. Occasions will arise when emotion is so strong as almost to eliminate volition and will power, and men's actions will become largely mechanical. Under such conditions habit will dominate

their actions; they will automatically revert to the mechanical processes to which they have been habituated previously. For example, a well drilled gun's crew, under a fire so heavy as to upset their mental equilibrium, will continue to serve their gun in a purely mechanical way, much longer than will a gun's crew whose drill has been neglected. The mechanical habits established by conscientious drill may become of vital consequence to control in battle. Habit is then doubly essential as a stabilizer for control. It furthers control through discipline, while volition is active, and also through automatism, when actions become merely mechanical.

But when the emergency is great, or emotion from any cause is at its height (when the gun's crew gets panicky), habit alone cannot be relied upon to ensure adequate control; more especially when it becomes necessary to perform some act to which the organization has not been habituated. Under such circumstances a leader may require not only the emergency brake of habit, but also an accelerator; which will be at his command if he is proficient in the art of suggestion, and understands the elements of crowd psychology. Such knowledge will also be useful as an aid to control under normal circumstances.

Both for individuals and crowds the following conditions favor their responsiveness to suggestion:

(a) Highly concentrated attention on one subject.
(b) Monotony of external surroundings.
(c) Restriction of bodily movement.
(d) Fatigue.
(e) Emotional excitement.

If the suggestion to be made is for immediate action, the most effective manner of making it is by example, more especially the example of a recognized leader of high prestige. Oral persuasion or direction is useful, but not so effective as the example of immediate execution.

When the object is not one calling for the immediate action of the crowd, but is to impregnate their minds with beliefs, other means of suggestion are best utilized. Simple affirmation, free from reasoning is very effective; especially if repeated constantly, monotony of repetition being carefully avoided by interspersing a variety of other related ideas. In addressing a crowd the effect of the last impression given is much greater than any previous ones, and this fact should always be utilized.

Psychology is rapidly emerging from the domain of fakirs and becoming more and more the concern of those practical men whose work requires the handling of other men collectively. In these modern times no leader can be considered proficient until he is able to turn to practical account some of the well proven aspects of psychology.

Besides certain attributes of character in the leaders themselves, and good organization, the principle of *control* requires first of all good discipline, in attaining which habit is the most valuable aid; second, sufficient drill and training to induce excited men to perform their respective tasks automatically; and third, facility in utilizing the power of suggestion.

While it is essential that leaders shall establish mental supremacy over their men by the above means, in order to control them properly; it is equally necessary that such domination shall not be so prominent as to incur their constant instinctive resistance. It is much better that the control be achieved almost without the subordinates themselves realizing it. This can be made possible only through a condition of psychological harmony; which will itself react in furtherance of control.

PRINCIPLE II. PSYCHOLOGICAL HARMONY WITHIN AN ORGANIZATION IS INDISPENSABLE TO ITS GENERAL EFFICIENCY

This is the second great principle of Leadership.

Whatever control is enforced over inwardly rebellious men costs undue friction and effort to overcome their hostility; and consequently the efficiency of the work in hand is lessened by the wasted effort involved. But, worse than this, repeated control in spite of covert opposition, forms a pernicious habit of insubordination in those so controlled, which inevitably will prove a serious menace in emergencies.

On the other hand, a condition of psychological harmony is a constant aid to the efficient performance of any task; and whenever such condition is habitual, it furnishes a most valuable means of inculcating instinctive obedience, and of creating the very highest state of discipline and general efficiency.

When we consider the importance of psychological harmony, together with the adverse influences of normal military and naval conditions—such as the surrender of personal freedom, the discomfort, hardship, and danger, and the many other detrimental

circumstances familiar to all—it is apparent that this question requires constant attention, and proficient handling, if the officer is to be a successful leader.

(a) *Justice* in the exercise of authority is a basic element in psychological harmony. This truth is too well understood to require argument here. It is important to note, however, that what counts most in establishing the spirit of harmony is not the *fact* of justice prevailing; but a general *belief* that such prevalence exists. The justice must be obvious to all. Pains must be taken by leaders, without undignified advertising, to establish the conviction among their subordinates that impartial justice is a primary consideration in the exercise of authority over them.

(b) *Understanding.*—As a rule the men and younger officers lack conviction as to the genuine need for many of the apparently minor requirements of military and naval life. Without such conviction these things undoubtedly assume an aspect of imposition and sometimes even of persecution; and cheerful compliance with requirements is then impossible. To couple an excuse or an explanation with every order obviously is to weaken authority and control. Yet if men are kept habitually in ignorance of the purpose of their orders, a great incentive to a cheerful spirit is necessarily lost. They must be kept generally informed of events pertaining to their work and of the intentions of those in authority, if the human interest and good will essential to the best accomplishment are to be aroused and maintained.

Of course it is not always expedient immediately to inform subordinates fully of the reasons for orders. But pains should be taken to do so as early as practicable. Meantime it is of the utmost importance that officers refrain from habitual growling and impugning the motives of higher authority. This is a most pernicious practice which promotes serious misunderstanding and a spirit of mutiny.

Information pertaining to current work is not all that is needed. If men are to submit cheerfully and willingly to our somewhat annoying customs and conventions, they must first be convinced that these troublesome usages play an important and necessary rôle in naval efficiency. The good health of men crowded together on board ship requires scrupulous cleanliness both of person and of habitation. This obvious fact is overlooked by many thoughtless men unless their attention is drawn to it with some frequency;

preferably supported by data. Neatness and orderliness are indispensable to coordinated effort; more especially under crowded conditions and in emergencies. Cleanliness and neatness both stimulate self-respect, without which men and efficiency degenerate rapidly. The rôle of etiquette, form and ceremony of all kinds, in creating and maintaining discipline—the lifesaver in emergencies—is more difficult to make men understand. But the pains needed to explain the underlying reasons for all these matters, so peculiar and inexplicable to the average recruit and even to many others, is more than repaid by the gain in psychological harmony.

Men must understand the objects and reasons for any troublesome effort, if they are to give a whole-hearted response to the demands made upon them.

(c) *Comradeship.*—Probably the most important of all the elements of psychological harmony is a spirit of comradeship. It is the surest antidote to the inevitable enmity felt by men reared in a democracy against what seems to them the despotic leanings of the military services. Strangely enough there has been less comradeship between American officers and men than between those of some European services. During the late war, the principal point emphasized by the British in the training of the large number of new officers was the imperative necessity for their establishing a bond of comradeship between themselves and their men. British practice in this regard perhaps would have a color of paternalism and patronizing that would be objectionable to American men. Nevertheless the principle is sound, and there is every reason why we should apply it; adjusting our methods to suit the conditions confronting us. It is of course very essential to avoid undue intimacy and familiarity, which the men themselves dislike and which experience has shown to be so disastrous to discipline and proper control over men. The requirements of Leadership impose some degree of reserve on the part of seniors and appropriate deference from juniors. When these bounds are overstepped Leadership is undermined; yet if they are too inelastic the consequences are equally detrimental. Good leaders learn and follow a middle course; which is not difficult for officers who have acquired poise, self-possession and *savoir faire,* and who have a fraternal feeling towards their subordinates.

Those who really feel comradeship will give unmistakable evidence of the fact in the numerous ways in which feelings are manifested to others—by bearing, manner, tone, general expression, etc.—ways difficult to define but familiar to all. Officers should strive to foster by their own expression reciprocal feelings towards themselves by the men; and to avoid careless rebuffs to their subordinates, who are apt to be hypersensitive.

An active earnest practical interest in the general welfare of subordinates is essential to feelings of comradeship on their part towards seniors. A good officer will keep an eye on his men's mess, to see that they get good food well served. He will be watchful that excessive work is not required of them without necessary cause; that through accident or design they are not deprived of money, leave and privileges which are their due; that unnecessary discomfort or other aggravating conditions are not imposed upon them; that they are not punished unjustly; that they have adequate opportunity and means for healthful recreation, etc. In these and many other things the officer must exercise foresight and take the initiative to safeguard the general welfare of his subordinates; many of whom through ignorance or diffidence will refrain from making reasonable protests, yet will harbor feelings of dissatisfaction and resentment against annoying circumstances.

Furthermore, a good officer will not hold himself too much apart from his subordinates—be they officers or men. Nothing contributes so much to a proper spirit of comradeship as a degree of sociability; more especially when combined with courtesy, cheerfulness and humor. Subordinates should be talked to, frequently, in a friendly human way, and not treated as though they belonged to a different species. A kindly "good morning" with a few words of personal interest goes a long way towards maintaining a spirit of comradeship.

It is also highly important that a directly personal relationship be established with each subordinate. Each one should feel that this individuality is not submerged into the impersonal mass of the organization; but that his own self is a distinct personality in which his seniors have a direct human interest. The daily work will offer ample opportunities for this; but it can be done most effectively whenever men are in trouble, or desire a special favor. A keen personal interest exhibited at such times solidifies the personal relationship in an amazing way. Such a relationship

makes it possible to handle successfully those with incorrigible leanings, and to command the good will and comradeship of all, to a degree that is otherwise impossible.

(d) *Recreation.*—A reasonable amount of recreation is normally essential to the mental well being and contentment of men; especially when they occupy positions of but little responsibility. It is an important part of a leader's function to provide diversion of a form sufficiently interesting to serve as recreation for their subordinates. The peculiar conditions of military and naval life frequently deny men opportunity for ordinary kinds of recreation, and at times unduly attract their attention to pernicious amusement. A good officer will be active and resourceful in devising and providing means for healthful, interesting recreation for his men, and will encourage their participation in it. Some tact is required on his part in guarding against too much paternalism, or too great a color of officialdom, both of which are distasteful to men in matters of recreation. If the means and opportunity are provided at the men's own suggestion, so much the better; but in any event the officer should keep in the background once any particular form of recreation is well started.

Justice in the exercise of authority, *Understanding* by subordinates of the reasons for the requirements and orders of higher authority, a *Spirit of Comradeship* between all ranks and ratings, and adequate *Recreation,* are four primary factors in the principle of psychological harmony. This principle is closely affiliated with that of control, the first one considered. They afford each other mutual support and furnish a good groundwork for leadership of men. But these are not all of Leadership; otherwise we might be content to command a herd of cows, in which control and psychological harmony are normally developed highly. With organizations of men, idealism or some other kind of inspiration is indispensable, if great achievement is to be counted among their capabilities. This leads us to the third principle.

PRINCIPLE III. SOME DEGREE OF EMOTIONAL INSPIRATION IS ESSENTIAL TO THE HIGHEST EFFICIENCY

The old prejudice against "too much contentment" has its origin in a belief that marked contentment can exist only as the result of slackness, and therefore of inefficiency. There is some ground for this belief; but only in cases where the officers are

deficient in the art of Leadership. With good leaders the most efficient organization is the most contented; a combination accomplished principally through various forms of emotional inspiration, the most important of which will be discussed below.

(a) *Interest* is a great stimulus to effort and achievement. When interest flags efficiency necessarily depreciates. When interest is aroused and maintained at high pitch, capacity for work and for accomplishment is greatly enhanced. A common method of killing interest is by unwarranted interference in the province of subordinate officers and petty officers. Both their province and their pride must be respected if their interest is to be sustained. Many ways of exciting and maintaining interest will suggest themselves to the resourceful leader; but most important of all is for him to exhibit repeated evidence of his personal interest in the endeavors of those under him. The influence of interest upon successful achievement is so great as to require the studied attention of leaders.

(b) *Self-respect* lies at the roots of all the higher instincts, and furnishes a foundation for the kind of inspiration a leader needs to give to those under him. Without a man possess self-respect no appeal to him, except of the most sordid and selfish origin, will awaken any higher response. A military organization composed of such men would surely disintegrate, unless held together by the most iron discipline based on fear and spoils.

It is almost universal practice to stimulate the development of self-respect by requiring men to keep themselves and their surroundings clean and neat; to maintain a smart carriage and manner; and to comport themselves respectably. This has a sound basis in the peculiar psychological principle that what attributes men habitually pretend to have they will actually acquire. Progress is doubtless often slow and imperfect, but nevertheless is real; and when assisted by public opinion and stimulated by the force of example it is usually rapid. Herein we see the reason for the emphasis laid on these seemingly trivial, but really very important, matters in all highly efficient services. Through generations of experience they have learned this fundamental lesson.

All ranks and ratings would doubtless take kindly to the necessarily irksome and constant task of keeping up external appearances, if they appreciated better the genuine need for it. The profound influence of example, and of the opinion of others, in

these matters imposes upon officers the important duty of themselves setting a good example of neatness, smartness and deportment; and of creating general opinion within the service in support of high standards in these respects.

A good leader will studiously avoid assailing the self-respect of his subordinates; by requiring lowering duties of them, by his manner towards them, or in other ways. He will on the contrary seek every means and occasion for developing their self-respect.

The pleasurable feeling of self-satisfaction and the human trait of pride furnish excellent self-respect builders. Praise and reward when merited, if utilized with judgment and moderation, are very useful to increase men's pride and satisfaction in their work and in themselves. It is good practice to be punctilious about giving due credit to men who have performed a special task well. Many other methods of fostering pride and self-respect will suggest themselves in the course of routine duty to officers who desire to make the most out of this method of giving needed inspiration to their men.

(c) *Esprit de corps* is based on collective self-respect; which furnishes a higher form of inspiration than does individual self-respect, because it is less selfish.

The relationship between *esprit* and loyalty is exceedingly close. One cannot exist without the other; they progress hand in hand. We cannot have adequate cohesion or coordination without loyalty and we cannot have effective loyalty without *esprit de corps.*

Good tradition is a great aid to *esprit* and is too much neglected in the navy; which should profit by the superior example of the marines in this respect. Men and officers should be made more familiar with the notable deeds of their predecessors in the navy, and in their own ships, or ships of the same name.

Competition offers one of the most useful means of stimulating pronounced pride and *esprit de corps.* Good leaders make it their habit to introduce the element of competition whenever practicable; between gun crews, boat crews, turret crews, divisions, watches, ships, or any other units which organization or circumstances shape into the semblance of a "team." Competition is all the more effective when successful efforts result; but even when a unit is frequently beaten its benefits will not be lost if officers take pains to point out evidences of improvement and to give encouragement for better efforts in the future.

When recruits are being handled, either in competitions or in ordinary work, the repeated suggestion that they are making constant progress has an excellent effect in creating *esprit* and in promoting the desired progress. Necessarily some criticism cannot be avoided with inefficient men, and it is a mistake to fail in frankness with them; but the practice of offering them nothing but criticism, more especially when couched in such tone or language as to offend their self-respect, individually or collectively, is ruinous to *esprit,* and is a certain indication that the officer so doing is not a leader. It is essential that a *habit* of pride and confidence be created; and this can be done only by repeated praise and encouragement.

An organization permeated with a firm belief in its own abilities is stimulated to undertake cheerfully much more difficult and daring tasks and to exert greater efforts to accomplish them, than if such confidence was lacking. Obviously, then, *esprit* is an element of great military value. It is important for leaders to understand that *esprit* is an abstract conviction of excellence, rather than the concrete excellence, and has a strong coloring of vanity in it. Men must be made to believe in their organizations' efficiency; probably to a greater degree, but certainly no less, than is justified by the facts.

Esprit can also serve many commonplace uses. It is said that at one period the higher command of the American Expeditionary Forces in France were greatly concerned over the serious congestion of the roads due to disregard of the traffic regulations. The ordinary road signs appeared to have no effect and the only solution seemed to be to increase greatly the traffic police force, at the expense of the trenches. A free use of the sign "Play the game!" posted near the traffic signs, proved an effective solution of the difficulty. The success of this simple appeal was due to the high *esprit* and loyalty of the American Expeditionary Forces.

Another example of utilizing *esprit,* while at the same time stimulating it, is given by the following quotation from a sign posted conspicuously near the gangway of a destroyer tender: "Yes, you can have it. If we haven't got it we'll get it; if we can't get it we'll make it. What is it?"

To a marked degree *esprit de corps* is a measure of the spirit of the officers. None but they can create it; only they can easily destroy it. It is no unimportant part of the duty of officers to build

up their organization spirit by studied suggestion at every opportunity, and by unremittingly scrupulous example.

The inspiration resulting from *esprit* has an important bearing on all forms of efficiency, and is cumulative in its effects. *Esprit* promotes special endeavor and therefore high efficiency. Successful achievement in its turn creates pride in, respect for and loyalty to one's organization, and hence still higher *esprit*.

(d) *Patriotism.*—Considering the oath taken by all officers on accepting their commissions, there can be no question but that officers who refrain from inculcating high patriotism in their subordinates commit a grave breach of faith and moral duty. This is obvious; but what is not so clear is that such neglect also denotes inefficient Leadership; in that the important source of inspiration to be found in loyalty to a high cause is not utilized.

Loyalty to a cause is the highest and most effective form of emotional inspiration. It will spur men on to undertake more difficult tasks, to exert greater efforts, to endure greater suffering, and to make greater sacrifices than any other incentive. The higher the cause, the more idealism it embodies, the greater will be the incitement. Excepting religion, there is contained in patriotism the highest and most idealistic cause that can animate man. Past history abounds in examples of the extraordinary inspiration due to patriotism. The future will offer an even greater impulse; since recent events have demonstrated that nationalism must survive if anarchy is to be avoided, and the greatest good to the greatest number is to be ensured. Such a cause is capable of inspiring the highest loyalty.

Even if neglectful of his moral duty actively to promote and foster patriotism among subordinates, an officer who is a good leader will not fail to utilize patriotism as an instrument of leadership. An appeal to patriotism, where it can be used appropriately, will rarely fail to bring spontaneous response; once loyalty to the country, its institutions, and its ideals has been firmly established in men's hearts.

The American officer is prone to be diffident before his men about so sentimental a thing as patriotism, and to take it for granted that their patriotism is sufficient for the practical needs of the navy and Leadership. Considering the youth of our men, their heterogeneous racial character, and the great amount of Bolsheviki and other pernicious propaganda that has been dis-

seminated recently, it appears to be necessary for officers to undertake seriously the inculcation of patriotism.

Loyalty to any cause presupposes inner conviction of its justice and efficacy, and firm belief in the ideals for which it stands. Our men must be made to understand that the sane development of American institutions is the hope of humanity, and that such development is not possible unless stability and security are afforded the country by an efficient army and navy; which are under a solemn obligation, at all costs, to safeguard and further the country's interests at home and abroad whenever called upon to do so.

A valuable means of promoting patriotism is offered by inspiring tradition, in which American naval, military, and political history is rich. Few of our men are sufficiently familiar with this history to cause a pronounced feeling of patriotism towards the country. They should be thoroughly acquainted with the inspiring facts; and if the best results are to be obtained these should be brought to their attention repeatedly, because repetition is one of the strongest factors in creating a habit of thought.

Above all officers themselves must set an example of fine patriotism; scrupulously respecting the flag, and taking every occasion, by word and deed, to stand for America.

Patriotism, together with Interest, Self-respect and *Esprit de Corps* are four principal agencies through which men receive the inspiration needed to meet adequately the unusual exigencies of military life. An equally important element of inspiration is the example of the leader, but since this factor is very potent in all other aspects of Leadership it assumes the importance of a cardinal principle.

PRINCIPLE IV. THE LEADER'S EXAMPLE AND CHARACTER ARE THE MOST POTENT ELEMENTS IN LEADERSHIP

In exercising Control, in creating Psychological Harmony, and in inducing a needful measure of Emotional Inspiration, the value of the example of the leader can hardly be overestimated. This is largely due to the fact that his position renders him so conspicuous that every act constitutes a suggestion to others; and the influence of repeated suggestion upon crowds is very great.

The leader should personify the principles for which he stands; the captain or executive who lies abed until noon cannot expect

the ship to be cleaned in the morning watch. If officers are slack their subordinates are sure to follow suit; if they practice what they preach, the struggle to make subordinates live up to the same principles is furthered *tremendously*.

In addition to the example of conduct, bearing and appearance which it is so necessary to set, one who aspires to be a leader must possess certain attributes of character; developed to a much higher degree than is required for proficiency in lower ratings. Before proceeding to a consideration of these character attributes, it is well to reflect that character development is a slow and tedious process requiring persistent effort. The earlier it is begun the greater will be the ultimate development.

The subject of military character is too broad and complex to be treated fully within the scope of this paper. All that can be attempted here is to furnish an outline upon which a reflective officer may formulate an adequate conception of the attributes most needful of development in his own particular case.

The essential qualities of character required by leaders segregate themselves naturally into three principal classes.

1. Basic attributes of individual efficiency.
2. Attributes pertaining to cooperation.
3. Combative qualities needed to cope with an enemy.

Let us consider these in sequence.

1. *Basic Attributes of Individual Efficiency.*—If the respect and confidence of subordinates are to be commanded, a mind which is to think for and direct them should be an efficient mind; and this means developed *mental capacity* in many respects. The decision which precedes every order should be a sound decision; it should have a background of good knowledge and memory; and should be based on accurate observation and reasoning processes, both of which presuppose well developed powers of application and concentration. Very often decisions must be made quickly; hence a capacity for quick thinking is exceedingly useful to officers. Many circumstances require good imagination if due foresight and resourcefulness are to be exercised; imagination is the great creative agent and needs to be highly developed in officers. A correct decision will frequently need the quality of understanding, which has its origin in judgment and a sense of proportion and reality. Finally the officer must possess a strong will, so that he will surely order done what his mind tells him is the correct

decision, and will adhere to such decision in the face of subsequent obstacles.

The foregoing qualities of mental capacity should be combined with high *ideals*. "Honor, virtue, patriotism, and subordination" are prescribed by custom and regulations; to which should be added high ideals of loyalty, justice and duty. An intellectual rogue is as undesirable in a military organization as a stupid saint. An officer must embody the reverse combination if his individual efficiency is to meet the requirements of his position.

2. *Attributes Bearing on Cooperation.*—It is not enough that each officer or man shall possess only those attributes which render him individually proficient. In armies and navies one of the most prominent and governing conditions is that great numbers of men are thrown into close association, and that their efforts require to be harmonized and coordinated if success is to be attained. Minor friction between personalities may readily prevent due cooperation, and reduce the capacity for useful collective effort to a dangerous minimum.

First let us consider a group of cooperation qualities which may be generally classified as *Social Attributes.* The fundamental basis of harmonious association with others is *Charity;* which is manifested by unselfishness, sympathy, consideration, and tolerance. Besides charity the quality of *Sociability* is of great use in promoting harmonious association. Sociability includes civility and a sense of obligation to the community; it is promoted further by amiability and volubility, and to a marked degree by sprightliness, cheerfulness, and humor. In addition to Charity and Sociability human experience demonstrates that a degree of *Polish* is essential to the permanence of harmonious association. One cannot be too unconventional without giving offence to some who may misunderstand his motives and intentions. Good manners are a much safer and more rational rule of intercourse, since they have a universally accepted meaning. Polish also presupposes sufficient *savoir faire* to give a degree of assurance and tact without which sociability is marred greatly. The foregoing *Social Attributes* embodied in Charity, Sociability and Polish are indispensable to harmonious intercourse and cooperation.

Another class of attributes bearing on cooperation may be grouped under the heading *Personality.* Foremost in this class is personal magnetism, which is probably less susceptible of culti-

vation than any other quality of military character. Yet its development is so important as to call for special efforts. Poise and prestige are also needed to round out a good military personality, and their acquisition will also further the development of personal charm and magnetism. Poise and prestige go a long way towards creating in the minds of subordinates a belief in the leader's fitness to command them.

The third group of qualities needful in cooperation may be called *Expressive Attributes.* Obviously a leader must express to his subordinates clearly and effectively his ideas and orders if his men are to interpret them accurately, intelligently, and coordinately. A leader should be at ease when talking to a crowd, and be able to express himself with facility, either orally or in writing. Otherwise it will be impossible to get into other heads what is inside his own head, and coordination necessarily will be hampered.

Coordination is one of the cardinal factors of efficiency in every field of naval and military activity. The three groups of character qualities considered above, Social attributes, Personality, and the Expressive attributes, all have a vital influence upon a leader's ability to get cooperation among his subordinates.

It is necessary to consider, finally, the

3. *Combative Qualities Needed to Cope with an Enemy.*—Hostile operations require first of all that leaders be pugnacious.

Pugnacity implies a degree of arrogance towards an enemy. It includes courage; which normally is not so much a question of character as it is a product of conditions—feelings of confidence in strength and efficiency, high morale, etc. Pugnacity presupposes great determination; together with self-reliance and decision. It includes abundant activity, as well as boldness, dash an ardor.

The great balance wheel to pugnacity is *Steadiness.* Coolne and clear-mindedness under tension are especially desirable in o who must make the responsibile decisions. To carry plans throug in the face of inevitable discouragements there are required ho ful buoyancy and much patience; besides highly developed endu ance—both physical vigor and mental persistence. All these gi steadiness.

Pugnacity with steadiness combine the principal combative cha acteristics, essential to cope with an enemy.

This completes the necessarily brief outline of the qualities most desirable in the military character.

Let us sum up the elements of Leadership. The basic principle is:

I. *A leader must exercise control over his subordinates.*

Control requires first of all, *discipline—i. e.,* instinctive obedience—and second, mechanical *drill.*

These agencies facilitate control not only in ordinary circumstances but also under the adverse influences presented by emergencies; and are established primarily through the medium of habit. A third factor in control is the proficiency of the leader in utilizing practically the power of *Suggestion.*

It is necessary that a leader shall establish supremacy over his subordinates through the above means; yet equally necessary that their inner hostility be not incurred. A paradox is avoided through the second principle, namely,

II. *Psychological harmony within an organization is indispensable to its general efficiency.*

Such harmony is obtained primarily through (a) a general belief in the prevalence of *justice;* (b) *understanding* on the part of subordinates of the need for the troublesome requirements of naval life and current work; (c) a spirit of *comradeship,* avoiding undue familiarity, between all ranks, and (d) adequate provision for interesting *recreation.*

The principle of psychological harmony is allied closely to that of control. They afford each other mutual support, and together furnish a good foundation for Leadership. Yet a third element is necessary, to avoid apathy and to supply an impulse for special effort.

III. *Some degree of emotional inspiration is essential to the highest efficiency.*

The most valuable agencies at the disposal of leaders, to give needful inspiration, are (a) *interest,* which may furnish a strong incentive under all circumstances; (b) *self-respect,* which is at the root of all the higher feelings; (c) *esprit de corps* (collective self-respect), which supplies constant inspiration for special effort and achievement by an organization; and (d) *patriotism,* a cause to which all can give the highest loyalty.

A capable leader will develop and make use of all these inspiring aids to the highest efficiency of his subordinates, and will utilize

also to the same end the influence of example. The importance of the latter is so great in its bearing upon all three of the preceding principles as to constitute a fourth cardinal principle of Leadership.

IV. *The leader's example and character are the most potent elements in Leadership.*

The force of the leader's *example* results from his being so conspicuous that his bearing and actions become constant suggestions for imitation by those under him. The example set necessarily depends to a great degree upon the leader's *character.* Military Character has three primary subdivisions: (1) Attributes of *individual efficiency,* whose principal components are ideals and mental capacity; (2) qualities bearing on *cooperation,* which comprise social attributes, personality, and expressive ability; and (3) the *combative* attributes, which are a compound mainly of pugnacity and steadiness.

A thorough understanding of the foregoing principles, together with facility in their practical application, is required of any officer before he can fulfil his primary rôle of a leader.

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STEEL TOWER CONSTRUCTION AT THE WORLD'S GREATEST RADIO STATION

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Historical

When, during the latter part of 1917, it became apparent that existing cable and radio systems operating between the Allied countries and America, although working at a speed hitherto unprecedented in any commercial service, were rapidly becoming clogged and that constant communication between Washington and Paris could no longer be guaranteed, General Pershing requested, as a war measure, that immediate steps be taken to furnish him with means of assured communication. Inasmuch as radio matters in the United States, during the war, were handled exclusively by the navy, the War Department referred the matter to the Secretary of the Navy, who, in order to communicate with the navy's widely separated ships and to make communication with the American Expeditionary Force in France absolutely independent of the cables and beyond the possibility of interference from other radio systems, authorized the construction of the most powerful radio station in the world. This station, now known as the Lafayette Radio Station, is located at the village of Croix d'Hins, in the Department of Gironde, France, about 14 miles southwest of Bordeaux.

Arrangements were concluded early in 1918 whereby all structural steel, radio machinery, equipment, rolling stock and material for camp construction was procured in the United States, while the French Government proceeded with the preliminary work of

grading and construction of foundations. The extremely bad weather conditions prevailing in southwestern France prevented completion of the construction camp until the middle of July, 1918, and shortage of shipping facilities so greatly retarded shipment of tower material that tower erection was not commenced until October 1, 1918. As the signing of the armistice and the cessation of hostilities rendered the military necessity for the station inoperative and eliminated the original motive for its construction, all construction work was discontinued early in December, 1918. The French War Department, after some consideration, expressed its desire to have the work continued as an after-war project, but being unable to procure French labor sufficiently skilled in such work to ensure speedy and economical completion, requested the United States Navy Department to complete the station for the French Government. With this request the American Government complied and, on May 4, 1919, work was recommenced with date of completion of towers fixed as January 14, 1920. All work, with the exception of painting, which was delayed on account of rain, was completed on December 1, 1919, 44 days ahead of contract time.

GENERAL DESCRIPTION

The installation consists of eight 26-panel steel towers, 1312 feet 4 inches on centers, on reinforced concrete foundations, the tops of which are about 12 feet above the surface of the ground. The towers are triangular in plan, 820 feet high, 220 feet center to center of columns at bases, 105 feet center to center of columns 215 feet above bases, and 9 feet 8¼ inches center to center of columns at tops, and are topped by a mast 18 feet high. The 20 upper panels are supported on a "portal," 215 feet high. The weight of each tower is estimated at 560 tons. The towers are set in two rows of four each, the centers of the towers being at the corner of 400-meter squares. The station will be able to transmit 72,000 words per day and will employ 500 k. w. on the antennæ. It will be more than five times as powerful as the Eiffel Tower Station, three and a half times as powerful as the Lyons Station and not less than twice as powerful as the strongest exist-

ing American, German and English stations. It will be possible, in fact, to radio to any corner of the globe, day or night—a feat not thus far accomplished.

The site is level and the soil sandy. In the rainy season, which extends from November 15 to May 15, the ground is saturated with water which frequently stands on the surface. During this season rain and high winds are practically continuous, so as to preclude any but shop work. In the summer conditions are ideal for tower erection, neither the weather being too hot nor winds too high to interfere with 12 hours' work daily. Ground water during this season falls to about three feet below the surface. On account of the sandy soil, which cuts up badly in summer and becomes soft and muddy in wet weather, it is impossible to operate motor trucks over the ground, and, accordingly, the handling of all structural steel and heavy material necessitated the installation of approximately five miles of standard gauge railroad track and the use of one saddle-back locomotive and two locomotive cranes.

TOWER DESIGN

The towers were designed for the following stresses:

(a) Dead load of structure.

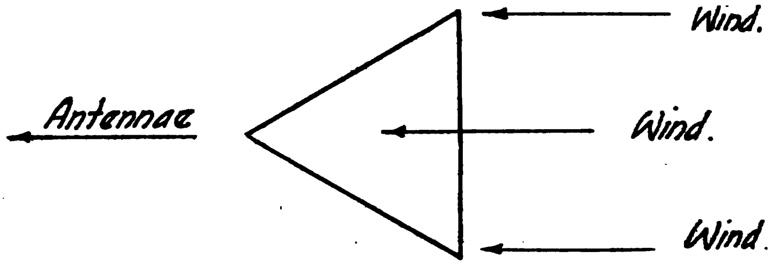
(b) Wind on the tower.

(c) Horizontal pull at the top from antennæ.

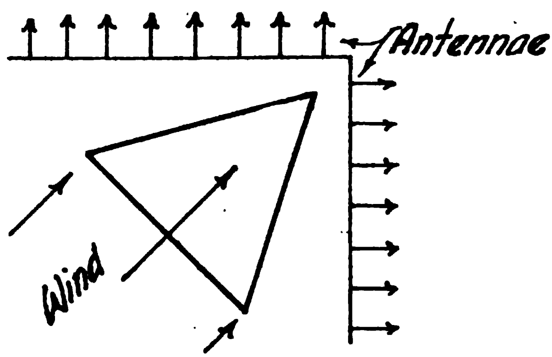
(d) Initial tension in diagonals.

The wind pressure used was 30 pounds per square foot. This is equivalent to a wind velocity of 87 m. p. h. by the formula $P=0.004\ V^2$, where P=pressure in pounds per square foot and V=velocity in m. p. h. The wind area was taken as $1\frac{1}{2}$ times the exposed area of one face of the tower—this on the assumption that the members on the leeward side, being somewhat protected, get one-half as much as the members on the windward side. The horizontal pull at the top of the tower was 22,000 pounds, which represents the resultant pull due to tension in the antennæ and the stress caused by the wind blowing on the wires. The initial tension (stress due to adjustment) in the diagonals was taken as 10,000 pounds and was considered only in designing the diagonals and struts.

In designing the columns, the wind and antennæ pull was considered as tending to overturn the tower over on leg thus:



In other words, the overturning moment due to wind and antennæ pull is resisted entirely by the compression in one leg of the tower. This condition was obtained with the antennæ wires arranged according to the original plans as follows:



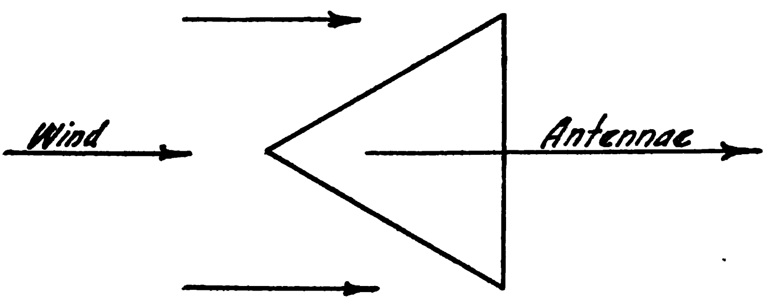
The arrangements of towers and antennæ wires was slightly changed before construction and, owing to the changes made, the members of the tower will not be subjected to as high stresses, but in the end towers, and in the intermediate towers when one set of wires is down, the condition will closely approximate that for which the towers were designed, and, accordingly, the design as originally made was not changed.

The unit stress allowed in designing columns was obtained by the formula $p = 18000 - 70 \frac{l}{r}$, where l = unsupported length of column in inches and r = least radius of gyration. The maximum allowable value of $\frac{l}{r}$ was taken as 120. For example: the stress

in column KL is 553,800 pounds, the unsupported length is 470 inches and the least radius of gyration 5.41 inches. The $\frac{l}{r}=87$ and unit stress equals 11,910 pounds. The area of section required equals $\frac{553800}{11910}=46.5$ square inches and the area of section used is:

2 channels	15″	at	50	pounds =	29.42 square inches
1 cover plate	16″	x	⅝″	=	10.00 square inches
2 side plates	12″	x	⅜″	=	9.00 square inches
				Total area	48.42 square inches

The unit stress used in designing the struts was obtained by the same formula as was used for the column, but the maximum



value allowed for $\frac{l}{r}$ was 150. These members, being in compression, were designed the same as the column sections. In this case, however, the area of the sections was determined by the $\frac{l}{r}$, for, with a section which gave the maximum value of 150 for $\frac{l}{r}$, the area was much greater than that required to take the stress in the member.

The diagonals take tension and were designed for a unit stress of 16,000 pounds. The base girders were designed to transmit the maximum stress from the columns into the foundations with the same conditions for which the columns were designed as stated above. The anchor bolts were designed to take the total uplift on the tower legs. The maximum uplift occurs with the wind and antennæ pull taken in the position shown above, and tending to overturn the tower about two legs. The uplift then equals the reaction thus produced at the windward base less the

weight of one-third of the tower. The amount of uplift in this case was 226,600 pounds and the area of anchor bolts required is $\frac{226,600}{16,000} = 14.1$ square inches. Two 3-inch diameter anchor bolts were used, giving a total area of 14.13 square inches.

ERECTION METHODS

The general scheme for erecting the towers was as follows:

First: All structural steel was delivered from freight cars to a central storage yard where it was sorted, carefully checked and stored. Then the practice was to assemble and rivet the column plates to the columns and to send out members to the respective towers for erection. Upon the location of this storage yard depends to a considerable extent the rapidity with which steel may be delivered to the towers. The ideal location for the central work shop would have been in the center of the rectangle formed by the end towers, but such location was impossible owing to the necessity of installing between towers an enormous amount of underground wiring used in connection with the radio installation proper.

Second: At each tower were built anchors or "dead men," for the program of erection below described. Three "main" dead men and six "wind" dead men were required for each tower. The "main" dead men restrained the legs from overturning until the structure was self-supporting and the "wind" dead men resisted transverse wind stresses.

Third: An "erection tower" was built on special concrete foundations provided for the purpose, this erection tower consisting of panels *J* to *P* of the main tower (see Fig. 1). The first two panels of these towers (roughly 81 feet high) were erected as a whole with 60-foot boom Brownhoist crane operating from a special spur track, while, for the remaining four panels, an 82-foot steel gin pole was used. This gin pole was supported in a bowl casting suspended by wire cable pendants attached to the portion of the tower already erected.

Fourth: After the "erection tower" was erected, three 120-foot steel booms were mounted on it for erection of the portal steel. These were stepped at panel point *N*, the supporting bracket being reinforced by a wooden strut. At panel point *N*,

wooden outriggers were built for attaching the swing lines, and, at panel point *P*, wooden members were provided for bracing the steel brackets to which the topping lift lines were attached.

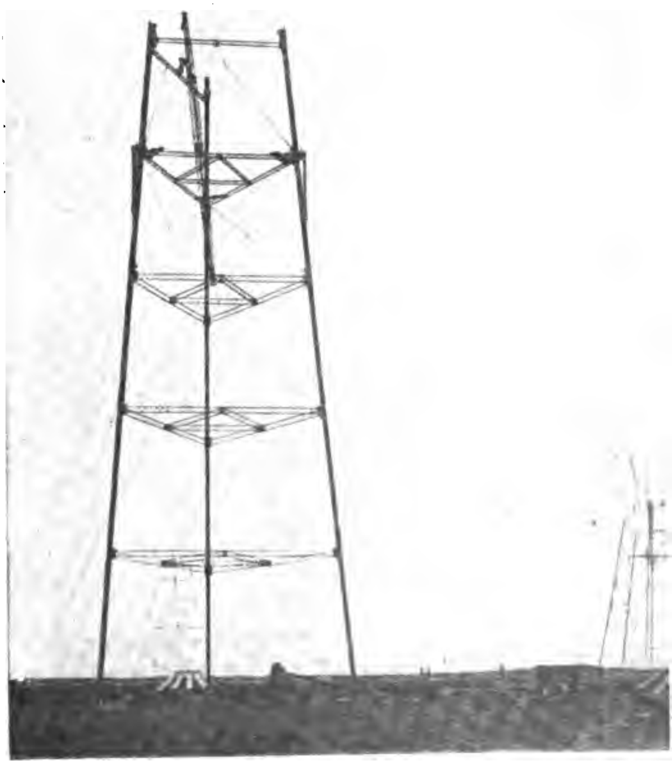


FIG. 1.—Erecting tower, consisting of panels *J* to *P* of main tower, used in erecting portal. Tower at right shows booms and rig used.

Fifth: After the booms were up and rigged and their respective hoists ready for operation, the portal steel was erected. The first guy was attached at panel point *B* and, when the leg had been erected to panel point *D*, a second guy was attached leading to the same dead man. As soon as the second guy was secure and tightened up, the first guy at panel point *B* was taken down.

Sixth: The *D* trusses and struts were riveted on the ground and hoisted in place as a whole. For this purpose all three hoists were used—the total lift amounting to 23 tons. As soon as the *D* trusses were raised to their proper elevation, the three legs were eased in by turnbuckles on their guys and the structure bolted up.

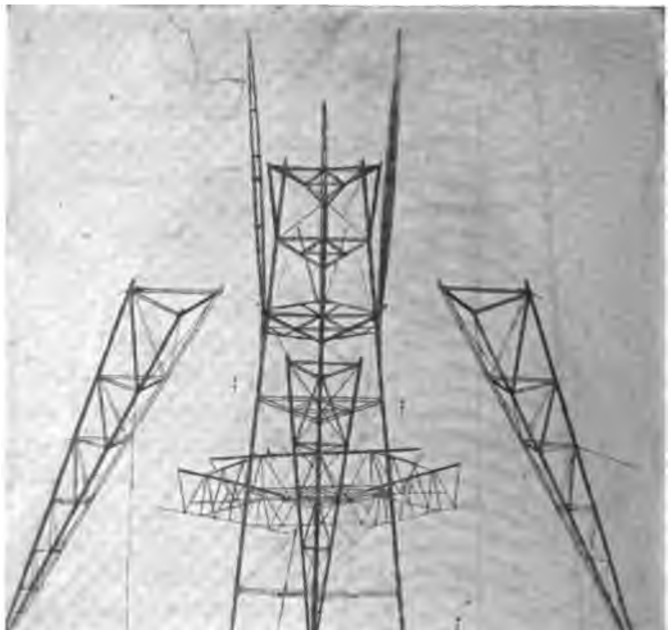


FIG. 2.—Placing D trusses at a single lift. Total weight 23 tons, span 101 feet. Note guys for main columns.

Seventh: The portal erection was then proceeded with as far as panel point *F*, a supplemental guy being attached at *F*. The trusses at *F* were also erected as a whole. To prevent distortion of various members, it was found necessary to retain all guys in place until the portal had been riveted (see Fig. 2).

Eighth: The columns of panel *F* to *G* were placed using the erection tower booms, after which these booms and the erection

tower were dismantled and a 130-foot length gin pole was sent up for the erection of the tower as far as panel point *L* (see Fig. 3). To support the *G* struts, 93 feet long, at their midlength, a temporary wooden member of 12″ x 12″ Y. P. was employed.

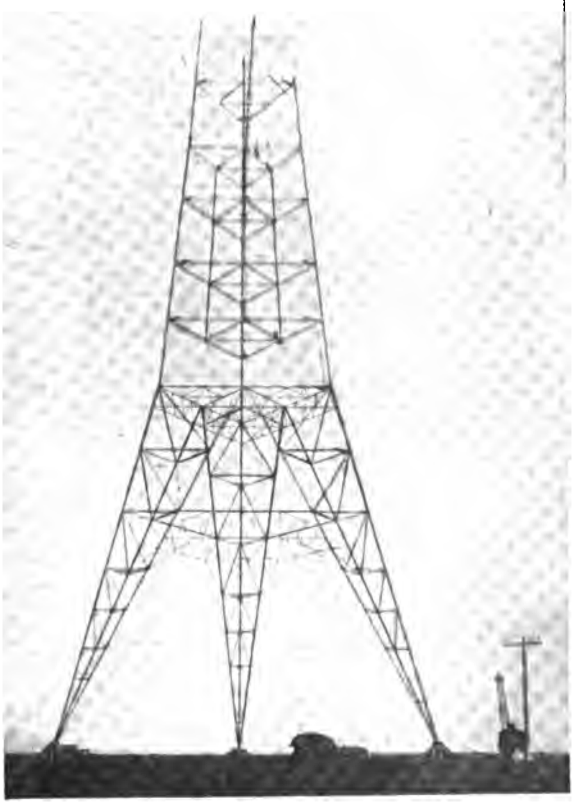


FIG. 3.—Erecting tower dismantled and being erected in place in main tower by 130-foot gin pole.

Ninth: At panel point *L*, a light gin pole 82 feet long was substituted for the heavy 130-foot pole and the erection completed by the suspended gin pole method. In order to reduce the interference of the interior struts with the gin pole when inclined the gin pole was supported as far as panel *J* from the middle of the horizontal struts instead of from the columns.

Tenth: As a safeguard against possible damage to the tower during erection through lack of sufficient bolts and rivets in connections, the following riveting schedule was rigidly adhered to:

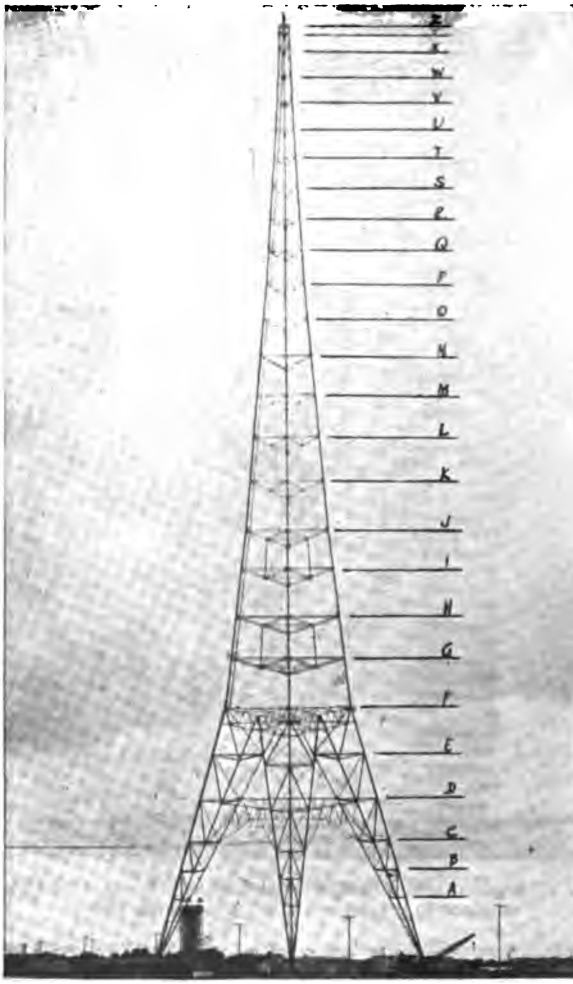


FIG. 4.—Showing completed tower and panel points.

(a) Steel may be erected to panel *H* without field rivets being driven below that panel.

(b) No steel may be erected above panel *H* until all rivets in panel *F* have been driven.

(c) Steel may be erected to panel *J* when all rivets in panel *F* have been driven and all panels below *F* have been bolted with not less than 60 per cent of the maximum number of bolts possible.

(d) No steel may be erected above panel *J* until all rivets below panel *F* have been driven.

(e) Steel may be erected above panel *J* without field rivets being driven above panel *F* provided 60 per cent of holes in column connections and 100 per cent of holes in strut connections at columns are bolted.

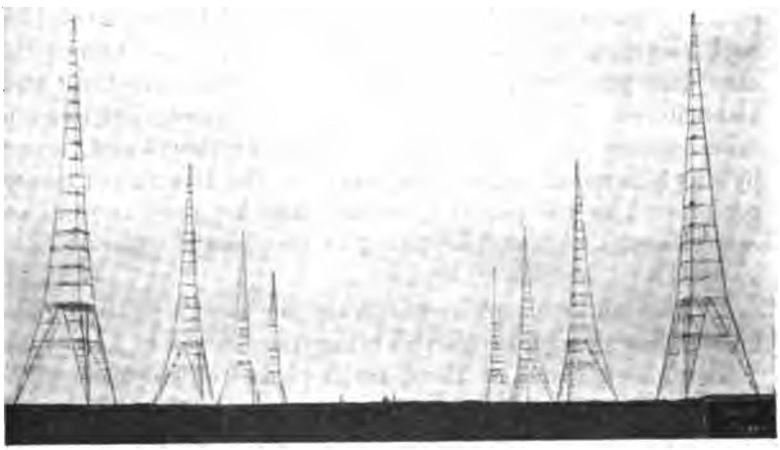


FIG. 5.—Completed project. Each tower is 840 feet high, including 12-foot foundation and 8-foot mast, and weighs approximately 570 tons.

Approximately 197,000 field rivets were driven, using air hammers.

Eleventh: Before erection all steel work was carefully examined as to condition of paint and places where the shop coat was not in good condition were well scraped, wire brushed, cleaned and given a fresh coat. Two coats of field paint were applied—one, Detroit Graphite Company's product No. 35 on the ground, and a second, the same company's product No. 59, after erection. Approximately 5000 gallons of paint were applied in the field by hand and paint spray.

EQUIPMENT

The power equipment at each tower (located in temporary sheds as shown in Fig. 5) consisted of:

2 double-drum hoists with 65 h. p. electric motors.

1 triple-drum electric hoist with 65 h. p. electric motors.

It was proposed at first to use steam hoists as a stand-by and six double-drum Lidgerwoods were furnished, but, owing to the reliability of the power supply and the excellent work of the electric hoists, the use of steam hoists was abandoned. Two 6-ton stiff-leg steel derricks, each with double-drum hoisting engine, were used in the central storage yard. One Brownhoist locomotive crane with 60-foot boom, one Industrial Works steam locomotive crane with 40-foot boom, one 4-wheel Davenport saddle-back switching locomotive and ten 10-ton 4-wheel French flat cars were provided for handling and delivering structural steel and material. To supply compressed air for riveting, painting and miscellaneous work, one Ingersoll-Rand air compressor, driven by a 35 h. p. motor and rated at 200 cubic feet free air per minute compressed to 100 pounds pressure, with air receivers and accessories, was located at central work shop and at towers Nos. 1, 2, 4 and 8.

Electric power was delivered to the site over a 3-phase transmission line at 11,500 volts, this being transformed to 2,200 volts, 3-phase, by a bank of three single-phase transformers. The power for operating hoists, air compressors and pumps for cooling water and camp use was 220-volt direct current. To obtain this, two 500 k. w. General Electric motor generators (one solely for stand-by purposes) were furnished. These sets start as induction motors and run as synchronous motors. The average daily power demands when work was in full swing amounted to 120 k. w. As an index of the rate at which work was done, it is interesting to note the power demands during different periods of the day—7 a. m. to 9 a. m., 48 k. w.; 9 a. m. to noon, 180 k. w.; 1 p. m. to 2 p. m., 72 k. w.; 2 p. m. to 5 p. m., 168 k. w. The maximum demand for any one hour was 300 k. w.

FOUNDATIONS

As stated above, in order that all preliminary work might be completed prior to the arrival in France of structural steel and

erection equipment, the French Government was requested to put in the foundations for all towers. A plan of the proposed foundations was forwarded from America, but, for unknown reasons, the American design, consisting of the ordinary mass concrete type foundations on piling, was not followed by the French, who adopted a type probably never dreamed of in America, and which has been stated in French engineering circles to be a *véritable merveille d'art*. The designer of this " marvel of art " is M. Harel

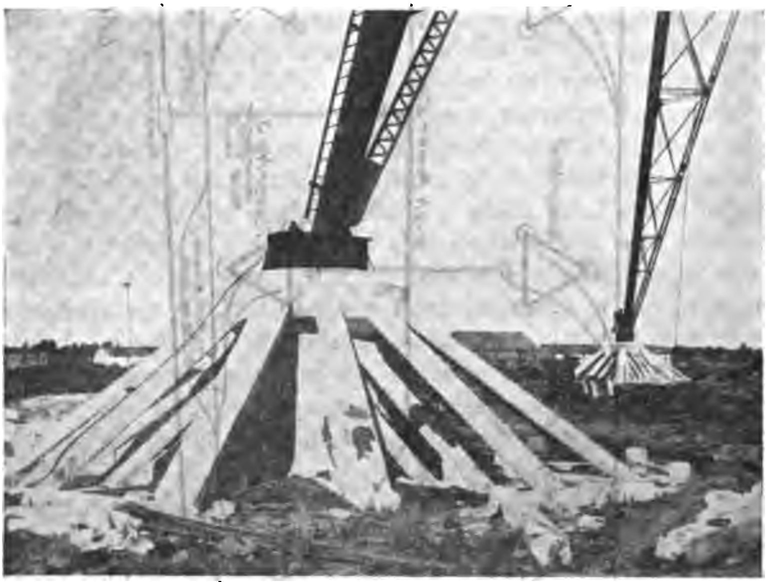
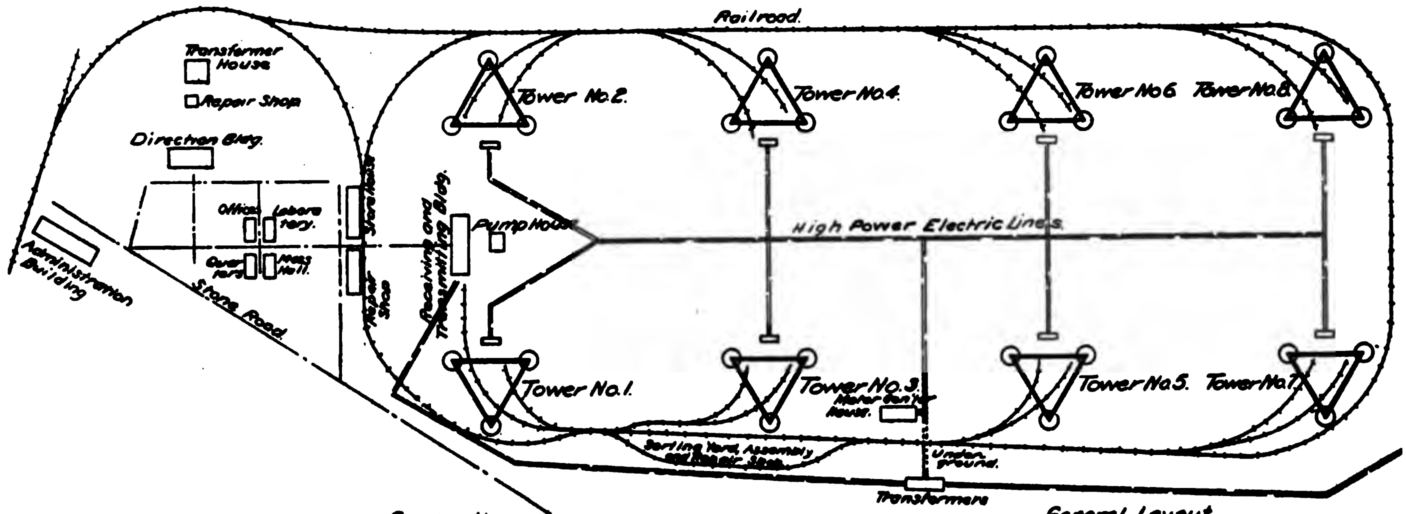


FIG. 6.—Foundation designed and constructed by French.

de la Noe, an eminent French engineer. The design (see Fig. 6) calls for a circular disc of strongly reinforced concrete, approximately 40 feet in diameter and 16 inches thick, supported by 28 precast square concrete piles, 35 feet long and surmounted by a central pedestal 12 feet high by 8½ diameter. The steel shoes for the tower columns rest on specially designed footings in recesses in the tops of these pedestals which are braced to the bottom disc by radial reinforced concrete buttresses. The elaborate detail of the foundations is entirely out of keeping with the simple and rather severe design of the towers. The mental atti-



General Layout
LAFAYETTE RADIO STATION.

tude on matters of foundation design of engineers of various nationalities is rather strikingly illustrated by the comments of several eminent engineers who have inspected the work. An American, "But think of the cost!"; an Englishman, "The severe, staunch appearance of your towers is ruined by the foundations"; a Frenchman, "*Véritable merveille d'art*"!

CAMP AND PERSONNEL NOTES

The actual camp construction work was undertaken, all preliminary work and 25 per cent of steel erection completed prior to December, 1918, by enlisted personnel of the regular and reserve forces of the navy. It is believed that never before has a project of such magnitude and unusual character been undertaken by any naval service, and the rapidity with which the work progressed and the excellent character of the work done remain a testimonial to the marked efficiency which the United States Navy had developed prior to the close of the Great War. When work was recommenced after the conclusion of the war, it was considered an injustice to the enlisted personnel of the navy to expect it to continue the work at the enlisted rate of pay, especially as the military necessity for the station no longer remained, and, accordingly, the Navy Department let the completion of the work by contract to the Pittsburgh-DesMoines Steel Company. By the conditions of its contract, the Navy Department furnished everything necessary for the work with the exception of labor. This included transportation of employees to and from France, food and housing for employees, office space and all equipment and material.

It is interesting to note the accommodations furnished the workmen. Owing to the isolated location of the station and, believing that contentment spells efficiency, every effort was made by the naval authorities to take care of the men properly. The results obtained may well serve as an example for others engaged in similar work in a foreign country. Space in navy standard portable barracks, which are light and airy, well ventilated and easily heated in winter, was provided at the rate of 500 cubic feet per man. A substantial iron cot with good springs, mattress, four sheets and two pillow cases was given each man. Foremen were assigned to separate barracks with double space. Superin-

tendents and office force were quartered in officers' barracks. Two medical officers and one dental officer were provided and furnished their services to all without charge. A dry canteen where navy standard shoes and clothing (uniforms excepted), candies, sweets, tobacco, soap and other necessary articles might be bought, was run by the government without profit. A branch post office where money orders might be purchased was established. Excellent messes for foremen and workmen were maintained and run by the government without cost to the employees. The food served was the navy standard ration somewhat altered to meet the requirements of steel workers. These messes were models of cleanliness and were up to date in every respect. They were run on the cafeteria system and all modern culinary apparatus was provided to ensure success. When it is realized that 400 men were served three times a day in less than 12 minutes per meal, it will be seen how thorough this detail was. There was scarcely ever a complaint received. The cost of the service to the government was extremely low, averaging about 90 cents per man per day.

Owing to the prevalence throughout France of skin diseases, which are spread chiefly by hand laundries where all kinds of clothing are washed in the same tub, or pool, it was found necessary to install a modern steam laundry to take care of the force's laundry. This was the only service for which the government charged, but charges were just sufficient to cover cost of operation and replacement. From the start the laundry was well patronized, and its use soon caused an abrupt drop in the number of admissions to the sick list.

To keep the men on the station and away from the hundreds of saloons, 10,000 licensed women in Bordeaux, and unknown thousands of unlicensed, a recreation hall was established. This had a seating capacity for about 600, and, through the courtesy of the Y. M. C. A., Red Cross and K. of C., it was possible to fit it up for theatricals and movies. Billiard tables, barber shop, library and reading rooms were also provided. Twice weekly performances were given by Y. M. C. A. entertainers and every other night movies. On Sunday, religious services, to which every race and creed was invited, were held. The value of this experiment is apparent to anyone who knows the tendency of men to commit excesses in a foreign country, where conditions are so

different from those existing at their homes. I am convinced that the almost total absence of "blue Mondays" on this work was due entirely to the wholesome amusement provided for the men in camp. The actual cost of this feature was less than $300, due of course, to practically everything being donated by the organizations above referred to. However, I feel sure that an expenditure of $10,000, had it been necessary, would have been wholly justified and would have paid big returns.

The design and general layout of this radio station was made under the Bureau of Steam Engineering, Rear Admiral R. S. Griffin, U. S. N., chief of bureau. The public works features, including the design and preparation of all plans for the towers, were carried out by the Bureau of Yards and Docks, Navy Department, Rear Admiral C. W. Parks (C. E. C.), U. S. N., chief of bureau.

The actual work at the site was begun under the administration of Lieut. Commander Geo. C. Sweet, U. S. N. (Retired), commanding officer, and under the personal supervision of Commander F. H. Cooke (C. E. C.), U. S. N., who completed the construction camp and about 25 per cent of the steel erection; and the work at the site was completed under the administration of Captain A. St. Clair Smith, U. S. N., commanding officer, under the personal supervision of Lieut. Commander D. Graham Copeland (C. E. C.), U. S. N., officer-in-charge, and Lieutenant A. C. Eberhard (C. E. C.), U. S. N., assistant. The construction work was handled for the Pittsburgh-Des Moines Steel Company of Pittsburgh, contractors under the Navy Department, by Mr. H. W. Smith, superintendent, and Mr. Loyd Ellis, assistant superintendent.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

OUR DIVIDED PERSONNEL

By Rear Admiral A. C. Dillingham, U. S. Navy

It is a mistake made by officers, who believe, that, with their retirement, their life's work is finished, because with many such officers, their experience, mature years and rank, their opinions on professional matters, are, more or less, respected, and if their influence is properly used, it might be of great value to the service.

My attention has been called to an article appearing in the New York *Times* of August 2, 1920,[1] entitled "Our Divided Navy—Questions of American Policy Brought to the Front by the Proposed Panama Maneuvers" and signed "Americus."

I believe that I recognize the writer of this article, as an officer of mature years, long experience, retired statutory on account of age, a student of naval history and strategy, who might possibly be called a pupil of Mahan's, one whose influence might be of great use to the navy, if properly applied.

The derisive style of the author and his indulgence in personalities, displays an effort to influence the public to accept his views of the condition of the navy to-day, as failing to meet the basic principle of organization, and a failure in administration to appreciate the mission of the navy.

I declare that the author violates the basic principle of administration, which is co-operation, that his method is obstructive and dangerous, and that he ignores and violates the best traditions of the navy. The result of the late investigation concerning matters in the navy, has apparently brought a division of sentiment amongst the officers, which is entirely wrong and damaging, and which, as a matter of fact, has no reason to exist, because, though the testimony of officers presented at the investigation may have

[1] This article appears in the Professional Notes, page 2018.

differed as to opinion, the fact and principle remained the same with all who testified. Without going into this investigation, I believe it can be said that every officer testifying as to his command, intended to declare the efficiency of that command, "as far as the circumstances would permit," and I believe that every officer knows, and believes, that our unpreparedness for war was, and is, absolutely up to the creative body, Congress. We must not forget that in our country there is no co-ordination of the makers or framers of policy, and the force that is to back that policy, and it is a fact that most of our troubles come from serving in a military profession in a non-military country and many from irresponsible legislation. But we cannot help this; our business in the premises (and this is the acme of efficiency) is to get results with what we have.

There is nothing new in what "Americus" says in his article; it is well known by all officers and, in the division of operations, that the basic principle of all organizations is simplicity and that it must be based upon logical principles and that, if the organization of the fleet is not ideal, or consistent with the requirements of battle, we will not get the best results from operations, though the administration be ideal. I believe it can be truthfully said that the administration of the fleet was never more nearly ideal, from a military viewpoint, than it is to-day, not that it meets entirely the requirements of ideal military administration, but it is more nearly that, than it ever was before.

Our navy is essentially a two-ocean navy, so that our extreme mission requires an organization capable of carrying on successfully war in the Atlantic, and in the Pacific, at the same time.

Under such circumstances the initial organization, which would represent our extreme mission, would divide the fleet into two parts, known as the Atlantic and Pacific fleets. The organization of these fleets is identical and permanent, so that it would make no difference in adding or subtracting units from one or the other.

We deviate from or leave the initial organization to meet the demands of the political aspects of the world, so that we can say that the composition of the fleet will depend upon the political aspect of the world, and this is in the hands of the Chief of Operations.

We are obliged, with our institutions, and with what the creative body, Congress, gives to us, to deal with expediences, and

that is exactly what the Chief of Operations is doing to-day. He is endeavoring to meet these expediences, and to, as far as possible meet the demands for a single fleet. I believe that officers will agree with me, and that Operations is of the opinion, that the same reason for a single command ashore exists for a single command afloat. If our extreme mission is to be so organized as to successfully carry on war in the Atlantic and Pacific at the same time " Americus " might possibly find in " proposed Panama Maneuvers " an effort on the part of Operations to test such an organization, or it might be that our lack of operating bases in the Pacific prevents mobilization of the entire force on that coast, or that economic conditions may require a division, nor must we forget that the mobility of our force is greatly increased with the Panama Canal in operation.

The present Chief of Operations is an officer of experience with a very level professional head, but, in his efforts he has not the co-operation of certain officers of the service, as is exhibited by " Americus "; he is obstructed and may be seriously obstructed by a public sentiment that " Americus " is endeavoring to create. I claim that this is not becoming a good officer and that it is violating the best traditions of the navy, which has always been loyalty to each other, with an *esprit de corps* which was admirable. The Chief of Operations is approachable; he is always accessible; he is ready to consider seriously professional advice or convictions, and the only proper way for an officer in the navy to better the service is to co-operate with the Chief of Operations, who is the military head of the navy. It was only a few days ago that I took the liberty of writing to the Chief of Operations a personal letter upon what I thought to be an important professional matter. I received, by return mail, a very full and considerate reply with assurance of his interest and his thanks for my suggestions. The same course is open to every officer in the navy and will receive the same attention.

I believe that the Chief of Operations is supported by a large majority of the officers in his efforts to put the navy on a solid foundation after its apparent slump since the World's War, but there are certain officers, " Americus " for instance, who do not co-operate with him, certain officers who by these anonymous letters and growling, display a destructive intention, that is lamentable.

We must have co-operation, for without it no administration will ever succeed, and though this Naval Institute gives to us an opportunity of presenting our professional views, I believe that it would be to the advantage of the service, if we could have once a year a convention of naval officers, where, as officers, and as man to man, open and above board, we could present our views and discuss them for the best interest of the service. This in no way could interfere or intrude on the prerogative of the War College, or any other institution that we might have.

Let us get back to our single aim—the good of the service; let us forget personalities, with our intense interest for the good of the service; let us demand that officers cease their efforts, especially in print, to pull down the military head of the navy by such articles as "Americus" sees fit to publish, and so follow the splendid traditions of our navy.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ADMIRAL NEARCHOS

By CAPTAIN C. Q. WRIGHT (Ch. C.), U. S. Navy

Among all the great men associated with Alexander no one has left a reputation more noble and unsullied than Nearchos. The long and difficult voyage in unknown seas which he successfully accomplished ranks as one of the greatest achievements in the annals of navigation.

Nearchos the Cretan, as he was called, must have been known more as a soldier and administrator than sailor when placed in supreme command of the 2000 vessels and rafts, large and small, of Alexander's fleet, in which he made but the one voyage—down the Indian rivers and along the coasts to the head of the Persian Gulf—though he is spoken of as an "experienced navigator."

Son of Androtimus, Nearchos was born in Crete, but in early life was settled at Amphipolis in Macedonia near the Thracian boundary. He is said to have been educated with Alexander under Aristotle, along with such other noble youths as Theophrastus, Ptolemy, and Harpalos, and afterwards remained in high favor with King Philip, till, because of his adherence to the Prince Alexander, he, together with his companions, was banished from the kingdom. Soon after Alexander succeeded to the throne he was recalled, and when the conquest of Persia was begun he took an intimate part with his leader in the earlier conflicts, and was appointed to govern the important districts of Lycia and Pamphilia in Asia Minor for five years. He appears to have acquitted himself so well in this employment that he was called to rejoin Alexander in Persia where he was counted among the royal favorites and confidants.

"He was one of the most distinguished of the friends and officers of Alexander." It is recorded that he accompanied Alexander in the Bactrian expedition in command of a body of mercenaries, and was present at the brilliant capture of the rock

Aornos, having rejoined the king in B. C. 329. In the ensuing subjection of the eastern part of the Assakenians, we are told that Alexander "sent out Nearchos and Antiochus—commanders of the hypaspists, the former with the light-armed agrarians—to examine the nature of the localities, and to capture, if possible, some of the barbarians who might give information about the state of matters in the country, and particularly about the elephants, as he was very anxious to know where they were."

Nearchos was counted among the learned ones of his day, and it is known that he wrote a history of the king's wars as well as books on natural history. While in Asia Minor he made extensive collections of observations concerning the plants and animal life, the habits, customs, dress, etc., of the inhabitants, and of the climate and geography of the countries far to the eastward—the latter at a later day. These notes on India were carefully and industriously compiled, and it may be that they were inspired by the king in anticipation of his invasion of that country. Neither these works nor his elaborate log of his famous cruise have survived, but they have been largely preserved in extensive quotations by later Greek writers.

As part of his far-flung plans, after the signal victory over Poros, Alexander gave orders for the immediate construction and equipment of a great fleet at the Hydaspes (at the newly built city of Nikaia), probably with a profoundly complex purpose, viz., as refuge in case of necessity; to complete the circuit of his eastern conquests; as a vindication of his rulership; and to link India, if successfully conquered, to his empire by sea as by land. As to the first, his wisdom was strikingly vindicated at the Hypasis, which his worn and wearied army refused to cross or to proceed any further, after so hardly reaching this eastern boundary of the Panjab (September, 326 B. C.). In this new and critical situation the ever-resourceful king had but to retrace his course to the Hydaspes and the sumptuous camp and building fleet to restore the health and spirits of his hosts, and to turn what might have proven a very embarrassing retirement into a triumphant completion of conquest.

Here, at his new city of Nikaia, while the fleet was being assembled, built, and equipped, he established a vast encampment, and inaugurated elaborate games and celebrations of his victories, and made division of spoil and treasure. And, when his soldiers

were happy and loyal again, he wisely sent home the ill and decrepit all well laden with honors and spoil. Others he placed in the numerous strongholds and colonies he was constantly establishing for the maintenance of his wide boundaries.

As to the construction of the fleet at the place chosen, it appears to have come about from two features or facts: the craft with which the Indus had been bridged were brought across country in parts to be used again at the Hydaspes, and this enterprise and the various transportation needs of the expedition had undoubtedly brought together here already a great number of boats, rafts, etc.; and adjacent was a large area of fine timber fit for building the larger vessels, and, besides the desirability of having its construction under his own keen eye, and in full view of the camp which supplied much of the labor, it was located in a fine and friendly country well supplied with food and other desirable materials.

Ere long a sufficient number of boats were in readiness. As no mention is made of Nearchos as having taken part in the battle with King Poros nor in the subsequent march to the Hypasis, it would seem most probable that he had been engaged in the supervision of this project, assisted by King Omphis of Taxilia and Krateros.

Among the 2000 vessels assembled there were eighty 30-oared galleys—some with a bank and a half of oars—and from statements of Nearchos it is probable there were 800 armed boats or war vessels and transports. When ready for final equipment, 24 Macedonians, eight Greeks, and one Persian were appointed captains of trierarchs, and, as was the ancient custom, "assigned the expense and honor of fitting out these larger ships." As to the army, it was instructed to forage in the adjacent rich country for 30 days before the time for departure southward, and most of these supplies were to be carried by the fleet.

But who was to command such an expedition? Who was capable of inspiring the men with confidence; or persuading them, that in undertaking such a service they were not abandoned to destruction? "Such," says Nearchos, "was the perturbation of Alexander when he ordered me to attend him, and consulted me on the choice of a commander. 'One,' said he, 'excuses himself because he thinks the danger insuperable; others are unfit for the service from timidity; others think of nothing but how to get home; and many I cannot approve for a variety of other reasons.' Upon hearing this, I offered myself for the command, and promised the king that, under the protection of God, I would conduct the fleet safe into the Gulph of Persia,

if the sea were navigable, and the undertaking within the power of men to perform." Alexander hesitated, he loved Nearchos, and admired him the more for the promptitude of his offer. . . . . Nearchos persisted in his proposal, and entreated the acceptance of his services. At length the king consented, and named him admiral of the fleet. Arrian introduces this account after the fleet had reached Pattala; but as Nearchos commanded during the passage down the Indus, it is much more probable that the consultation took place before his first appointment.—VINCENT.

"Nearchos the Cretan was made admiral of the fleet and old Onesicritus or Onesicrates the pilot of the royal galley, both destined to win immortal fame by their accounts of the voyage they were beginning." As the admiral did not always follow the nautical advice of this sea-guide of the king's vessel, and as the latter has been detected in falsely describing himself as in command of the fleet, it may have transpired that some jealousy and disagreements cropped up between them during the long and trying cruise upon which they were entering.

Unfortunately, the admiral's journal or log of the voyage was subsequently lost—like almost everything else connected with Alexander's realm and reign—but, as mentioned, the substance has been preserved, principally in the writings of Arrian, so that we are able to reconstruct from the surviving fragments an intelligent and profoundly interesting sketch of his cruise.

Having refreshed and supplied the army, and equipped the fleet, Alexander, who ever retained supreme command of both when in touch with them, now placed some 8000 men on the fleet, together with the heavier impedimenta and treasure, as well as spare horses (on vessels specially built for them) and some of the great savage dogs which had been presented—150 of them, said to have been bred from tigresses—by King Sophytes. When all was in readiness, Alexander made the following disposition of the army:

He took in the ships along with himself all the hypaspists, and the archers, and the agrarians, and the corps of horse-guards. Krateros conducted a division of infantry and cavalry along the right bank of the Hydaspes, while Hephaistion on the opposite bank advanced in command of the largest and best division of the army, to which the elephants, now about 200 in number were attached. These generals were instructed to march with all possible speed to the palace of Sophytes—[probably to enable the admiral to replenish his stores, and it may have been also to arrange for control and exploitation of the extensive gold and silver mines in that vicinity; and another large body of troops was to follow them after three days. Mos

probably Nearchos carried his own troops with him aboard, and utilized many of them to man his fleet—an early instance of the "Soldier and Sailor too"—in fact, a body of his force afloat is spoken of as *marines*.]

All now being ready, "after solemn offerings to the gods of river and sea, the great fleet at dawn of some day in October, 326 B. C., pushed out upon the current, and in stated order started down towards the sea," without chart or compass or experienced local pilots—at least, it may be said that none of the native pilots employed by Nearchos appears to have been familiar with the entire stream nor with the whole stretch of rivers to be traversed. As it was the flood season, the situation called for local knowledge of shores and streams continually—for the guidance of the marching troops and the drifting fleet. Nearchos could not go far ahead of the troops, as he carried not only the commanding king, but much also of their gear and supplies, and 8000 soldiers, and the resistance of some of the tribes encountered was strong and persistent till they were conquered, reconciled or destroyed.

The end of Alexander's conquests had been reached, and the return to peace and settled life had begun. Standing in the prow of the royal galley, he poured from a golden goblet libations to each of the rivers on which he was to sail; again he poured to Hercules, to Ammon, to each of the gods whom it was his wont to invoke; and then the trumpet rang out, the oars moved, and the strange argosy was on its way towards the unknown ocean.

All the long cruise on the rivers, until the sea voyage was begun, Alexander kept with Nearchos's fleet, voyaging in his royal galley—in fact, in command, as has been said, of both fleet and army, though the admiral carried out the king's orders and wishes, or executed them on the water, nor is there any indication of fault-finding by Alexander nor of clash of authority.

As to route and methods, the king seems to have determined to follow the course of the Persian explorers before him, descending the streams flowing most directly southwards to the ocean; but he had no thought of leaving a single enemy or possible local rival behind him, so that he must have set himself the strenuous task of the conquest of all the great tribes en route, and this he appears to have accomplished during the eight or nine months consumed in the river cruise.

Proceeding down the Hydaspes to its junction with the Akesines, and down that river to its junction with the Hesidrus, Nearchos had but a short 60 or 75 miles to make till he floated

out upon the wide brown bosom of the Indus which was now to be his highway to the mysterious sea.

At the junction of the Akesines another memorial "Alexandria" had been built; and on the way several tribes and large districts had been conquered. Of these the Mallians proved the most troublesome. It was in the taking of their capitol that Alexander came so near capture or death, and was so seriously wounded, and these events and his thrilling display of noble courage and military skill are all graphically related by Nearchos in his log, where he also records the intimate fact that some of the king's closest friends and companions (he himself, no doubt, among them) now went in a body to his galley, where he lay so sorely wounded and ill, and ventured, after some hesitancy, to remonstrate with him for having so recklessly exposed himself in this last affair, and urged that such should be the duty of the common soldier and not of the general, which grieved Alexander, though he embraced them later and generously commended them for this, another evidence they had given him and the gods of their loyalty. But there was present, Nearchos says, an old soldier who (he may have been a privileged character there) made bold to say aloud, "Deeds, Alexander, tell the man," and glibly quoted from Aeschylus the line, "Who does must suffer," which amused and pleased the suffering king greatly.

To allay the despair in the army and fleet caused by reports of his death, "it was necessary, as soon as he was able to be moved, to show him to them alive, on board a vessel which was floated down the current without the use of oars, to avoid all shock and noise."

Just previous to this campaign, Alexander had overrun the territory of the Sibi who claimed to be descendents of soldiers of Hercules who had been left behind there because of illness. But after many days of hard fighting they were overcome and obliterated. Of one of their cities it is said, "the inhabitants, despairing of their safety, set fire to their houses, and cast themselves together with their wives and children, into the flames. The citadel of the town had escaped damage, and Alexander, accordingly, left a garrison behind in it. He was himself conveyed by boats around the fortress—three rivers there washed the base thereof."

Surprise and some disaster awaited the admiral at the junction of the Indus. The pilots, finding they were not strictly guarded,

absconded, and he sent out in search of others, but none were obtained, and the rest of the voyage had to be made without any pilots other than a few inexperienced natives of those parts who earnestly endeavored to guide the fleet though they possessed little or no knowledge of the course of the river, its currents, depth, shoals, tribes to be encountered, etc., or the distance to the sea.

Another disastrous event encountered here was the *bore* of the Indus. The streams met with a tremendous roar, and formed a deadly vortex.

The meeting of the rivers makes the water swell in great billows like the ocean, and the navigable way is compressed into a narrow channel by the extensive mud-banks kept continually shifting by the force of the confluent water. When the waves, therefore, in thick succession, dashed against the vessels, beating both on their prows and sides, the sailors were obliged to take in sail but partly from their own flurry, and partly from the force of the currents they were unable to execute their orders in time, and before the eyes of all, two of the large ships were engulphed in the stream. The smaller craft, however, though they were unmanageable, were driven on shore without sustaining injury. The ship which had the king himself on board was caught in the eddies of the greatest violence, and by their force was irresistibly driven athwart and whirled onward without answering the helm. He had already stripped off his clothes preparatory to throwing himself into the river, while his friends were already swimming about not far off ready to pick him up, but as it was evident that the danger was about equal whether he threw himself into the water or remained on board, the boatmen vied with each other in stretching to their oars, and made every effort possible to force the vessel through the raging surges. Suddenly the waves parted and the currents subsided sufficiently for the boat to be stranded on the shoal near by.

Alexander there erected as many altars as there were rivers, and, after sacrificing on them, prepared to march onward.

After reassembling, refitting, and rebilleting his ships, Nearchos declared all in readiness again, after a considerable delay, and the voyage on the Indus was begun, the two armies marching on either side as before, and meeting with frequent and serious warfare, subduing the adjacent country along the route. Nearchos relates the circumstances attending the capture of some of the philosophers who were known to have persuaded their kings and princes to resist Alexander and who were, therefore, held responsible for much of the bloodshed and loss that ensued. These sages, being adepts in the art of returning brief and pithy answers to hard questions, were put through their rôles by Alexander with a number of difficult questions in the presence of his friends and

sages, and then dismissed with appropriate presents. Onesicritus, the royal pilot, being a Cynic philosopher, was sent to the most renowned of the sages, who lived in seclusion, one of whom, Kalanos, he persuaded to visit Alexander, and who consented to continue with the king. It was this Kalanos who afterwards, when in failing health, so Nearchos relates, immolated himself on a pyre in the presence of the wondering camp in Susa.

The admiral found many surprises on the Indus, and the task of keeping in touch with the army, supplying its needs, besides the constant care of his vessels, to say nothing of the strenuous problems of navigation which arose continually, all combined to tax his utmost ability and strength, yet he appears to have borne up bravely and triumphantly to the end.

In a way, the voyage down the rivers was a kind of triumphal procession. "The size of the vessels, the conveyance of horses aboard, the number and splendor of the equipment attracted the natives to be spectators of the pomp. The sound of instruments, the clang of arms, the commands of the officers, the measured song of the modulators, the responses of the marines, the dashing of the oars, and these sounds frequently reverberated from overhanging shores"—altogether it was a magnificent experience, and one which must have aroused the pride and joy of those who shared in it. Arrian freely attributes the happy consummation of the enterprise to the prudence and judgment, as well as the courage, of the admiral.

Finally, after the lapse of so many crowded months, the mouth of the Indus was reached, at Patala, where Alexander ordered the construction of a ship-yard, harbor, and fortifications. And here another big surprise was encountered, for, proceeding then to explore the delta, "Alexander made his astonished acquaintance with the phenomenon of the tides; then, without returning on the sea, he contented himself with a three-day journey along the shore, in order to form an idea how a fleet was likely to fare in a coasting voyage." Presumably, he was accompanied on this three-day trip of level-headed investigation by his admiral and pilot. From this point they were to proceed without him.

It seems that the fleet had been brought down the western arm of the Indus, and that it had been impossible to gather any dependable information as to the river or the distance to the ocean from the few natives encountered along the banks. At last, they were

able to observe the meeting of the fresh and salt water, and thereby knew that they were about to arrive at the Outer Sea toward which they had been so long voyaging. Alexander now exhorted the oarsmen to pull with all strength, eager to reach and see this strange sea.

Ere long, some of the men began landing on the banks and shoals in quest of fresh food, when, after a time, they discovered the salt water rolling inland in great waves that broke over the beach and the boats, and great confusion ensued. Many vessels were damaged, others lost with much of the baggage and not a few lives also. After this marvellous experience, the tide began to flow out, and then many vessels were left high and dry ashore, or on the reefs and shoals, some of which careened and spilled their deck loads or sustained other damage and loss. The terror inspired in the people proved as disastrous as the collisions and strandings and careenings of the ships. In the confusion the alarmed pilots shouted orders which could not be heard, or if heard were not heeded, and, altogether it required the combined influence, wisdom and exertion of the king, admiral and subordinate commanders to bring order out of the chaos thus caused by novel terrors and forces of the tides. Night coming on, and anticipating a return of the tide, horsemen were sent down to the mouth of the river with instruction to watch for signs of its rising and to hasten back with the news, and when this was done, the people were warned and placed in readiness to man the ships and to refloat such as had been stranded, and when all this had been accomplished successfully there was great rejoicing in the fleet, so that preparations were soon begun for the works which Alexander had projected preparatory to his own and the fleet's departure. Then Alexander offered sacrifices to the gods of river and sea.

The admiral met with yet another trouble here, for his men, after being so much in salt water, broke out with sores which left scabs on their bodies, causing much distress and discouragement. But he had them rub themselves with oil which served to heal them, and thus he overcame this difficulty also, and preparations were finally finished.

"Then, as the country through which the army was to pass was dry and waterless, Alexander sent on Leonnatus in advance to dig wells. In the meantime he built several cities, and ordered

Nearchos and Onesicritus, who were experienced navigators, to sail with the stoutest ships down to the ocean, and proceeding as far as they could with safety to make themselves acquainted with the nature of the sea. The winter being now well-nigh over, he burned the useless ships, and marched homeward with his army by land," having instructed the admiral to prepare for his voyage along the same coast with the largest and most seaworthy ships, and to rejoin him finally by sailing up the Euphrates. Thus started the great king on his terrible march along the Gedrosian coast, "leaving the admiral to wait till the setting of the Pleiades should bring the change from the southwest to the northwest monsoon, and insure a quiet sea and a wind fair or on the beam" and off the coast. Bunbury says, "When we consider the total ignorance of the Greeks at this time concerning the Indian seas, and the imperfect character of their navigation, it is impossible not to admire the noble confidence with which Nearchos ventured to promise that he would bring the ships in safety to the shores of Persia, 'if the seas were navigable and the thing feasible to mortal man.'"

Nearchos wished to defer his departure till the monsoon had quite subsided, but as he was in danger of being attacked by the natives, who were no longer overawed by the presence of Alexander, he set sail on the 21st of September, 325 B. C. He was forced, however, by the violence of the weather, when he had reached the mouth of the Indus, to take refuge in a sheltered bay at a station which he called Alexander's Haven, and which is now known as Karachi. After a detention here of 24 days, he resumed his voyage on the 23d of October, but met with contrary winds which detained him off the mouth of the Indus till about the 1st of November, when, at last, the admiral set sail on what was to prove a tremendously novel yet fairly prosperous and successful voyage along the cost of this ocean and to the head of the Persian Gulf.

The army's route was lain as nearly parallel with and as near to the sea coast as practical in order to maintain, as far as possible, communication with the fleet—probably for mutual benefits and comfort. After Alexander had left the admiral and set out on his hazardous journey, he left Leonnatus with a strong force to overawe the Oreitai and await the safe passage of that coast by the fleet. These precautions seem to indicate that Nearchos expected to depend upon this coast for water and supplies in case he

was detained too long by bad weather, or met with disaster; and there are mentioned about 21 places at which the fleet stopped en route.

He encountered many dangers from rocks and shoals, and after losing three of his ships in a storm, he arrived at Cocola where he tarried some days to overhaul his vessels. It was while thus employed that he succeeded in establishing communication with Leonnatus, who had been left behind in charge of the province of the Oreitai, and obtained from him provisions, and reinforcements of men. But from this point on to the Carmanian coast, Nearchos was absolutely dependent upon his own resources, and all his patience and commanding genius and great personal force were put to the utmost test because of the violent discontent in parts of the fleet that arose out of the want of food, and the superstitious terrors encountered. Of the latter were the schools of great whales that spouted, and the mysterious perils of the "enchanted islands," in connection with which he describes himself as "the only man in all the fleet who did not fear enchantments." "At a fishing village called Mosarna, he for the first time obtained a pilot acquainted with the coast, which greatly facilitated his farther progress."

Among other strange experiences, the admiral mentions that of the terror felt by his people upon first encountering spouting whales which they finally frightened off by their loud cries and other noises; and of the many peculiarities of some of the savages met with; of sheep whose flesh was rendered unpalatable by the dried fish they subsisted on, etc. Earlier in the cruise he had been taken by surprise by hearing "in India parrots talking like human beings," and, of course, others had been equally surprised, and probably the fleet was well fitted out with these and other pets and curiosities as has been the case with naval craft in all ages—till recent conditions and orders discouraged it.

Arriving in sight of the promontory of Ros Musandam marking the Arabian side of the Persian Gulf, and disregarding the advice of Onesicritus, the pilot now of the fleet, Nearchos hugged that shore, and thus successfully sailed into the straits, and in a few more days reached the mouth of the river Anamis (now the Minab), where he moored his fleet, and gave general liberty to his men. Fortunately, as he relates, one of these men, sailor like, mounted a horse and went exploring inland a short distance where

he chanced to encounter a mounted soldier under arms who spoke Greek through whom the location of Alexander's encampment was soon made known to the admiral, who lost no time in communicating his arrival, and in reporting in person to the king.

Extracts which have survived from his log serve to give the following summary of the voyage from the western mouth of the Indus to the Persian Gulf:

> Coasting the shores of the Arabies for 80 miles, he reached the mouth of the river Arabies (now the Purali), which divides the Arabies from the Oreitai. The coast of the latter people, which was 100 miles in extent, was navigated in 18 days. At one of the landing places the ships were supplied by Leonnatus with corn, which lasted ten days. The navigation of the Mekran coast which succeeded occupied 20 days, and the distance traversed was 480 miles, though Nearchos in his log says 10,000 stadia or 1250 miles. The expedition in this part of the voyage suffered great distress for want of provisions. The coast was barren, and the savage inhabitants (fish-eaters) had little else themselves to subsist on than fish, which some of them ate raw. The Karmanian coast, which succeeded, was not so distressingly barren, but was, in certain favored localities, extremely fertile and beautiful. Its length was 296 miles, and the time taken in its navigation was 19 days, some of which, however, was spent at the mouth of the river Anamis, whence Nearchos made a journey into the interior to apprise Alexander of the safe arrival of his fleet. There was now no honor too great for Alexander to show his admiral. His delight was unbounded. He said, and confirmed it with an oath by Zeus and Ammon, that he rejoiced more at the news of the safe arrival of the fleet than at being the possessor of all Asia.

This might indicate that the fleet carried a most important cargo other than the personnel, viz., perhaps the vast Indian treasure which would be in urgent demand now that the immense treasure left at Babylon was lost having been squandered and made way with during the king's absence in the east.

Harpalos, superintendent of Alexander's treasury, was left in charge at Ekbatana of the vast treasure which had been taken thither from Susa and other captured cities of the Persian empire, but he soon took up his abode in Babylon and assumed the high office of satrap, while the king was absent in India, and there squandered untold millions in outrageous living, till, hearing of Alexander's return to Susa, Harpalos absconded with most of the balance of the treasure—5000 talents.

Nearchos visited the camp from the Anamis at the end of December, 325, and, "At the king's command he related to the

army the story of his marvellous voyage—and all were proud of the leader who had caused them to accomplish this great thing."

Alexander was unwilling that Nearchos should be further subjected to the hardships of voyaging and the attending dangers, and he asked Nearchos to find another to whom he could surrender his command, but Nearchos demurred and urged his request to be permitted to finish his task.

After extravagant and prolonged celebration in the camp and fleet, preparations were made by Nearchos to explore the coast up to the head of the Gulf, and, accordingly (January, 324), he set sail thitherward, while the army marched on towards Susa, where the fleet arrived February 24.

Nearchos had intended to sail up the Tigris, but having passed its mouth unawares, continued sailing westward till he reached the Diridotis (Teredon), an emporium in Babylonia on the Pallacopas branch of the Euphrates. He thence retraced his course to the Tigris, and ascended its stream till he reached a lake through which at times it flowed and which received the river Pasitigris (the Ulai of Scripture, and now the Karun), and proceeded up this river till the army was met near a bridge on the highway from Persia to Susa. The fleet anchored at the bridge on the 24th of February, 324 B. C., so that the whole voyage was performed in 146 days.

This time is exclusive of the eight or nine months consumed in the river cruise before the commencement of that along the seacoast, thus the entire cruising covered 13 or 14 months.

DISTANCE SAILED ACCORDING TO VINCENT

	Miles
From Jamad to the mouth of the Indus	625
Coast of Arabitai	75
Coast of Oritae	98
Coast of Ichthyophagi	480
Coast of Karmania	280
Coast of Persia	350
	1908

The voyage of Nearchos from the Indus to the Euphrates is the first event of general importance to mankind, in the history of navigation; and if we discover the comprehensive genius of Alexander in the conception of the design, the abilities of Nearchos in the execution of it are equally conspicuous.—VINCENT.

At the encampment in Susa was inaugurated the celebration of Alexander's victories, and of the joining of sea and land, and of

east and west by his enterprise and prowess—typified solemnly in the ceremonies attending the marriage of the king and 29 of his noble companions to princesses, of whom the daughter of Mentor, his own step-daughter, was allotted Nearchos. She was the daughter of Barsine—Alexander's mistress after Mentor's death.

Alexander gave them all (the brides) handsome dowries, as he did the more than 10,000 brides who had been married, by his order, to Macedonians. Nearchos and the other companions most conspicuous for personal bravery, loyal devotion, and signal achievements received golden crowns as a special mark of royal favor. Nearchos was among those mentioned as having dissuaded the king from entering Babylon on account of the predictions of the Caldaeans.

The admiral's successful voyage led to the project of circumnavigating Arabia to the isthmus of Suez, and by the end of May, 323 B. C., the fleet and army were in readiness for the expedition, but on the morning of June 2 the king fell ill. He was able to appoint the departure of his army for the 5th, and of his fleet for the 6th of June. "In the evening he went by boat to the gardens across the river, there bathed and slept." Doubtless Nearchos and other favorite companions attended him there. On the morning of the 4th he conferred with Nearchos and other officers of the fleet, and "charged them to be ready to start on the day after the next, for he counted on being well enough to set out at the appointed time. The fever steadily increased. On the 8th it assumed a dangerous form. Towards evening of June 13 he died, 30 years and eight months of age, having reigned 12 years and 10 months."

With the untimely death of the great king all immediate plans for the operations of the fleet and army were abandoned, and the whole face of the known world was changed. Alexander's house fell and great was the fall thereof.

After the death of Alexander when Perdikkas proposed a temporary leader pending the birth of the prince—Alexander Aigos, son-to-be of Roxana—"Nearchos declared it his opinion that there was no need of waiting for any other heirs, since Herakles, the son of Alexander and Barsine, had a right to the throne. But the soldiers tumultuously rejected this proposal." Prince Herakles was Nearchos' brother-in-law.

The fortunes of Nearchos shifted with the splitting up of the vast empire, and his connection with the fleet soon ceased. "His tranquil and unambitious character did not qualify him to take a leading part in the stormy dissensions that followed." Subsequently he was allotted his old districts in Asia Minor. Later he joined with Antigonus against the party of the so-called royal family in Macedonia which was led by Eumenes, and, supposedly, he shared in the downfall of Antigonus (301). "Nothing is known of his history after the year 314 B. C. when he was selected by Antigonus to assist his son Demetrios with his counsels when left for the first time in command of an army." Associated with him under the leadership of Antigonus were such old companions as Ptolemy, Peithon, and Seleukos; and one of the last references to him in the history of those bloody days is to the effect that he alone remonstrated (in vain, 'tis true) against the execution of Eumenes when his troops had treacherously delivered him into the hands of Antigonus. Vincent thinks he fell in the battle of Ipsus where Antigonus was slain (301 B. C.).

Admiral Nearchos was magnanimous, loyal, learned, patient, enterprising and courageous, evidently beloved and trusted by his men and officers, as well as by his companions in arms and his king, and he was a man well worthy to have set the high tradition of the sea, and an admirable example of the fine gifts and high traits of the ideal naval officer.

Thus was the fleet of Alexander conducted in safety from the Indus to its destination.

"ΟΥΤΩ ΜΕΝ ΑΠΕΣΩΘΗ ΑΛΕΞΑΝΔΡΩ ΕΚ ΤΟΥ ΙΝΔΟΥ ΤΩΝ ΕΚΒΟΛΕΩΝ ΟΡΜΗΘΕΙΣ Ο ΣΤΡΑΤΟΣ."

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A METHOD OF GUN CONSTRUCTION BY RADIAL EXPANSION

By Commodore S. J. Brown (Math. C.), U. S. Navy

Early in March, 1917, when it appeared that the United States would be drawn into the European War, a proposal was made by Prof. P. L. Bridgman, of the Jefferson Physical Laboratory, Harvard University, to the Bureau of Ordnance to construct a 3-inch gun by a new method. As outlined in his plan, Professor Bridgman stated that if adopted it would produce precisely the same distribution of stress which is found in a built-up gun, but by a much simpler and less expensive process than the method generally in use.

The principle involved in the method was clearly outlined in the proposed plan as follows:

If a hollow thick tube is exposed to an internal pressure great enough to stress all the fibers to the elastic limit, when the pressure is removed the external layers will shrink back on the internal layers and leave them in a state of compression. It may be proved that the final state of stress in such a tube, which has been permanently stretched, is precisely that which would be obtained under the best possible condition in a built-up gun; but these conditions are never realized in practice.

The proposition of constructing guns is, therefore, as follows: A *single* piece of steel of the outside dimensions of the finished gun is roughly bored to approximately the required diameter; it is then stretched by one or more applications of sufficiently high internal pressure; the pressure is then released and the inside is machined to the size necessary to take the liner; the liner is inserted, thereby finishing the gun except for mountings and fittings. The very great economy of this method, both in time and in money, as contrasted with the old method, is apparent. The stretching of the gun might possibly be a matter of a day.

The reason that this very simple method is not at present in use is that the pressures necessary to produce the initial stretching are much higher than the pressures which can be handled by means commonly known. For

example, if the steel of which the gun is to be made has an elastic limit of 45,000 pounds per square inch, the necessary preliminary pressure must be as high as 120,000. Such pressures in liquids cannot be dealt with by usual methods without excessive leak.

To mention a single example, several years ago a method was projected at the Watertown Arsenal for testing guns by the application of high hydrostatic pressures, but the method had to be abandoned because pressures higher than 60,000 pounds could not be retained without leak.

In this connection I am in a position to place at the disposal of the government a technique by which pressures high enough to insure the success of the proposed method may be easily handled. For over 10 years I have been engaged in the Jefferson Physical Laboratory of Harvard University, almost exclusively in research on various effects of pressures much higher than have been previously investigated. The previous range of scientific high-pressure work has been 45,000, or at the most 60,000, pounds per square inch, whereas as a matter of daily routine I have been employing up to nearly 200,000 pounds. This, of course, has involved the invention of the methods of packing and other details of technique which are novel or at least which are not employed elsewhere to my knowledge.

The proposal to construct a gun by this novel method was referred to the Special Board on Naval Ordnance. It was found that the cold stretching of steel had been a matter of daily practical application for many years, as illustrated in the manufacture of wire and cold-drawn tubing, and it had been demonstrated many years before that the cold stretching of steel and other metals beyond the elastic limit, thereby producing a permanent set, resulted in a decided increase in the elastic strength of the metal thus treated.

The board, therefore, in view of this increased elastic strength, as well as the stresses introduced in the walls of the cylinder, recognized the practicability of the proposed method when applied to symmetrical cylinders of small dimensions, but considered that the application to large irregular masses involved in gun construction would present difficulties requiring much experimental work.

At that time the government equipment, as well as at many industrial plants, had been built up to follow the present system of manufacture of built-up guns at comparatively great speed. It was not considered expedient at a time when the greatest output of standard weapons was demanded that any changes should be made in the well-established system of manufacture of built-up guns. The Navy Department had neither the personnel nor the facilities for the experimental work involved in testing the merits

of this new theory of gun construction without interfering with the production of guns of standard design. Moreover appropriations had only recently been made for building a naval laboratory for testing just such theoretical questions, and while the value of Professor Bridgman's proposals from his long experience in laboratory work was fully recognized by the bureau, it was decided to defer such experimental work until it could be undertaken with the resources to be provided in the new naval laboratory.

While investigating the proposal of Professor Bridgman, it was found from the files of the bureau that in the fall of 1914 Md. A. H. Emery, a prominent mechanical engineer, had brought to the attention of the bureau an identical process of gun construction, covered by patents from 1903 to 1908, in which he proposed to produce initial stresses in the gun metal by a process of stretching beyond the elastic limit, employing for this purpose hydraulic pressure in the interior of the bore. As these plans were evidently presented verbally, there is no record of the action of the bureau beyond a paragraph in a letter of December 9, 1914, in which the bureau informed him that it considered his method of doubtful value, as the same results could be obtained under the present method of gun construction, by using higher pressures in the gun bore and thereby raising the elastic limit of the material if this should be considered desirable.

In April, 1917, the subject was again brought before the Bureau of Ordnance by the Naval Consulting Board, which recommended the construction of two 5-inch guns by Mr. A. H. Emery and Professor Bridgman, working in conjunction, at an estimated cost of $85,000. The proposed method was again carefully considered by the bureau, which, while conceding the importance of the proposed method, was unwilling to undertake the extensive experiments which the proposed construction of two 5-inch guns required, on the ground that attempts at that time to change the system of gun construction in the navy, in view of the pressing needs for war material, were inadvisable. The proposal was brought to a termination by the action of the Naval Consulting Board in withdrawing their letter recommending such experimental work.

On account of the very small estimated cost of the experiments proposed by Professor Bridgman, he was entrusted by the chief

of the bureau with the application of his ideas to the construction of a 3-inch 23-caliber gun, similar to the Mark III, Model 4, landing gun. Experiments were to be conducted under the general supervision of the Special Board of Naval Ordnance, and the superintendent of the naval gun factory was requested to give Professor Bridgman all possible assistance in working up the design for the forging and the necessary machinery required for producing the hydraulic pressure. Although the naval gun factory early in June took up the design of the accessories necessary for the construction of the 3-inch gun, in accordance with his ideas, it was not found practicable to complete the working drawings until the following October, when it was estimated that the forging for the press could not be made before the end of March, 1918, and its completion not before June 30. This delay was due to the urgent demands upon the gun factory for supplying standard materials which had preference over any experimental work.

The gun forging and accessories were finished early in June and taken to the Bureau of Standards, where arrangements had been made for utilizing its two-million pound Emery testing machine as the source of pressure for the experiment. It was designed to use this powerful machine, for producing the hydraulic pressure in the gun, by forcing a cylindrical 3-inch steel piston terminating in a packing into a specially constructed cylinder of 3-inch bore, thereby compressing the fluid in the interior of the cylinder, in the further end of which was a fixed packing. To this latter was attached the end of a system of hollow tubes, ⅛-inch internal diameter, communicating with the interior of the gun, and conveying the pressure from the cylinder to the gun. The pressure packings in the gun were constructed on the same general design as the packings of the pressure cylinder, one fixed in the breech end of the forging, and a movable one to be shifted as desired.

The first pressure experiments were begun July 20, on the larger section of the gun tube, 7.5 inches external and 2.5 inches internal diameter. There was evidently very great friction in the movable packing of the pressure cylinder, and further difficulties in the congealing of the liquid in the tubes connecting with the gun, as the final pressure recorded by the Emery testing machine was 1,300,000 pounds which, without these two causes, should

have given 170,000 pounds per square inch in the bore of the gun. At this point the connecting pipe burst, and the pressure in the gun was thereby relieved. It was found upon examination that the 3-inch steel piston for forcing the movable packing into the

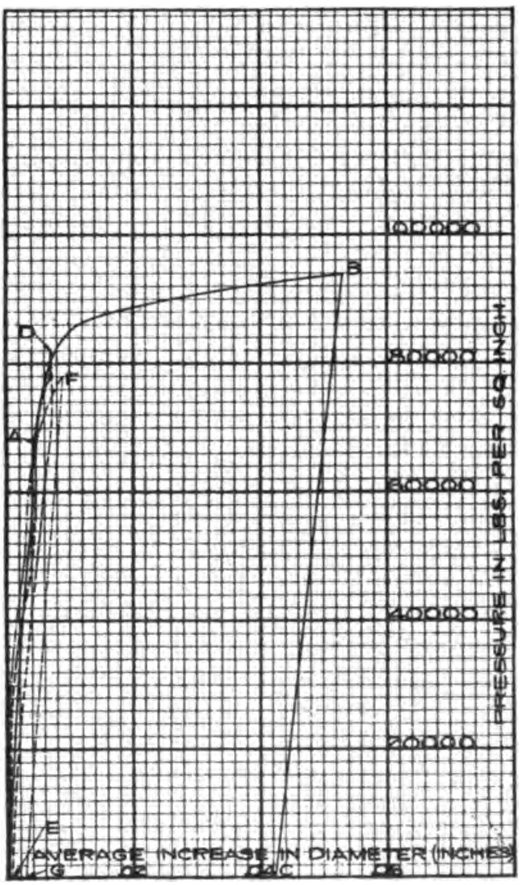


FIG. 1.

pressure cylinder was deformed, necessitating the removal of cylinder and piston to the navy yard for repairs.

The records of diametral expansion, as the pressure was gradually increased, indicate a temporary enlargement of .016 inch, or .0021 per linear unit. This elongation per unit of length of the outer layer corresponds to the elastic limit of the metal.

about 60,000 pounds, which is determined by the ratio of this elastic limit to the modulus of elasticity of steel, 30,000,000 pounds, about .002. Although the electric gauge for reading the pressures at a point in the connecting pipe just before reaching the gun recorded a pressure of 95,000 pounds per square inch at that point, it is certain that the pressure in the gun was considerably less. It may be said parenthetically at this point that, from the mathematical theory of the strength of hollow cylinders stretched by interior pressures beyond the elastic limit, knowledge of which was obtained later in the experimental work along these lines, this pressure and resulting radial expansion were sufficient to give practically all the benefits to be obtained by the process of radial expansion.

The experiment was resumed July 26, with a lighter oil, and the pressure gradually increased up to 94,000 pounds, recorded as before on the shunt pressure gauge, when the connecting pipes again burst. The mean diametral expansion in this case was .042 in, or .0056 per linear unit. The pressures and corresponding elongations are recorded on the stress-strain diagram, Fig. 1, from which it will be seen that the metal of the gun worked elastically up to about 78,000 pounds. This great elastic strength was undoubtedly due to the cold stretching to which the gun had been subjected on the 20th.

The following day the movable packing was shifted to a point near the muzzle, thus exposing the whole length of the bore to the pressures which were effected on the 27th and 29th. The pressures were carried to 78,000 pounds, producing a permanent elongation of the smaller external diameter (6.3 inches) of .075 inch, or .012 per linear unit. (See Fig. 2, Curve *A-B,* for stress-strain diagram.) The permanent elongation of the larger section was only .0004 per linear unit, the point *A* in the diagram, Fig. 1. showing that the metal worked elastically up to about 70,000 pounds. Although the experiment was now complete as far as the elastic strength of a gun of such dimensions could be carried, it was again subjected on the 29th to a pressure of 82,000 pounds, the progressive elongations showing that the metal of the gun walls was acting within the limit of its elastic strength, up to 72,000 pounds for both sections.

The cold-stretching process having terminated sastifactorily, the gun was sent to the Naval Gun Factory for machining, boring and

rifling, after which the finished gun was mounted on a regular 3-inch mount for that type of gun, and sent to the Naval Proving Ground for firing tests, which were terminated November 30, 1918. Only 14 rounds were fired, the first five the regular proving rounds for the 3-inch landing gun, the remainder with increasing pressures until the last three reached 21.8 tons. The test was then stopped on account of damage to the firing pin, which required the return of the gun to the Naval Gun Factory for repairs of this

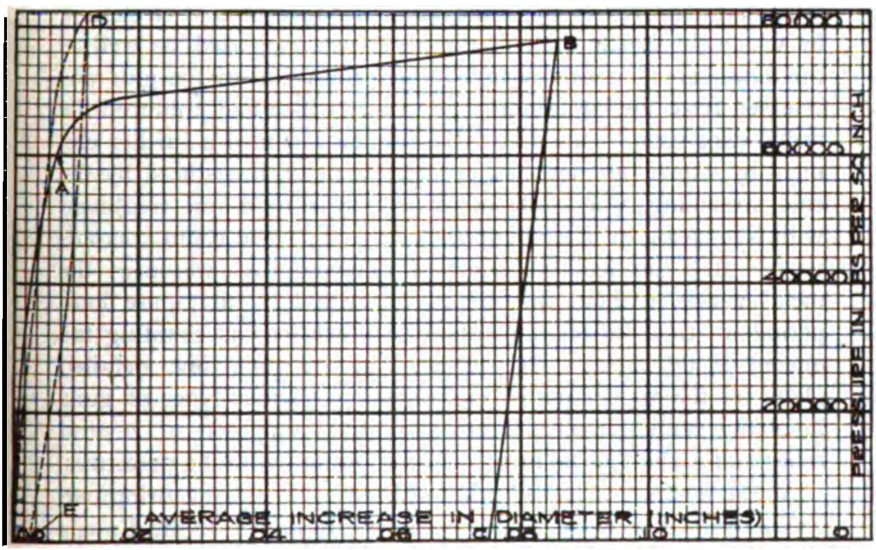


FIG. 2.

element. The gun upon examination showed no injurious effects from the high pressures in the last few rounds.

Before the firing tests were completed confidential information was received by the bureau that this system had been in use elsewhere in the construction of experimental guns for a period of about 20 years. The tests of these guns had been of such a conclusive nature that it was considered unnecessary to continue further high-pressure firings, as owing to its small caliber and the short travel of the projectile it would not have been practicable to subject it to sufficiently high pressure to tax the great elastic strength of the gun, which the experiment indicated ought to be approximately 72,000 pounds.

During the design and construction of the 3-inch gun on the plans proposed by Professor Bridgman, Mr. Emery had frequently appeared before the Special Board on Naval Ordnance advocating the extensive use of his process, on which he had obtained letters patent in 1903, and inviting attention to the fact that the construction of the 3-inch gun under Professor Bridgman's plans was an infringement of his patent rights. The specifications of his patent, the original application of which was made in 1897, embraced many practical details of accessory apparatus, and appeared to cover the basic principle of cold stretching by which the elastic limit of the metal was increased, as well as the *autohooping* which occurred when the metal of the gun was released from the high internal pressures which had produced the radial expansion of the tube. His process included a further element by which the increased special elasticity, introduced by the cold stretching, was made permanent by a mild-heat treatment with live steam at a temperature of 250°F. The claim was advanced that this had the effect of relieving the fatigue of the metal which, without this treatment, would require quite long periods of time for its elimination—a process of accelerating the *ageing* of the metal. He presented, at the same time, detailed plans for the application of his process to various types of guns involving both one-piece guns and guns composed of several tubes and jackets to be fitted by appropriate hydraulic pressures.

As the method of construction utilized by Professor Bridgman was described in great detail in the specifications of the Emery patents, which were apparently valid, and had been called to the attention of the Bureau of Ordnance in 1914, Mr. Emery was authorized early in September to proceed with the construction of a 4-inch 50-caliber one-piece gun, from designs which he had prepared and submitted to the bureau, shortly after the withdrawal of its proposal by the Naval Consulting Board.

The Tioga Steel & Iron Company was authorized to manufacture a special 4-inch forging in accordance with drawings furnished by Mr. Emery, which was completed, inspected and accepted, and sent by express to the Naval Gun Factory on December 10, 1918. The boring and machining of the forging to the required dimensions for the application of the stretching process was completed, and the gun sent to the Bureau of Standards, where the large Emery testing machine was to be utilized in pro-

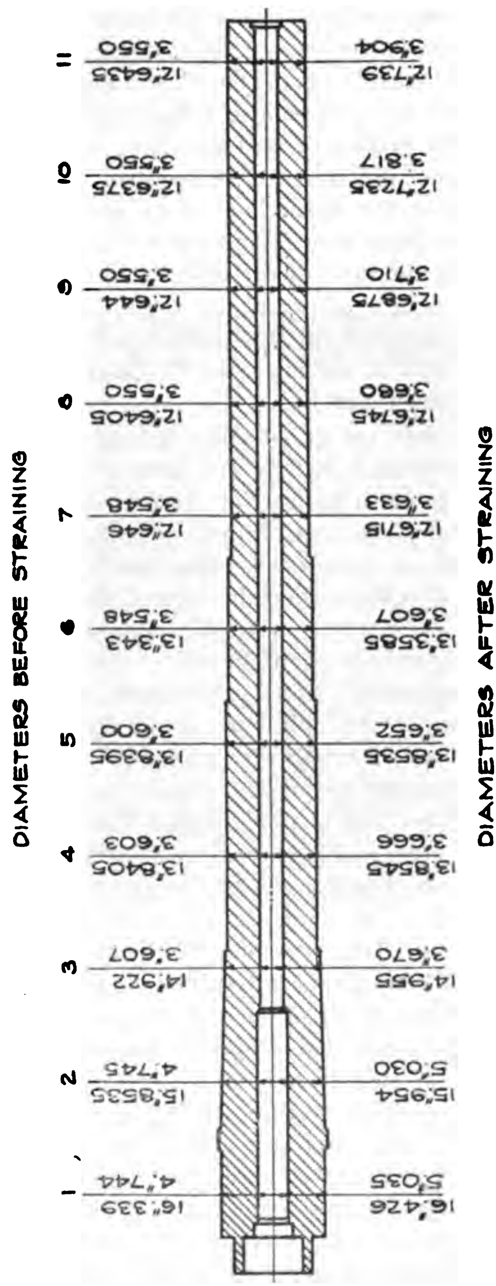


FIG. 3.—Four-inch Emery Gun, Strained January 2, 1919.

ducing the required pressures. Test specimens were taken from the breech and muzzle sections of the forging, representing the inside, middle, and outside metal. The elastic and tensile strengths of these specimens were determined for comparison with similar specimens after the process of cold stretching. The forging was so designed that the application of the required pressure for cold-stretching the gun to the elastic limit of the exterior layer would be effective at the same time for all sections. This was accomplished by making the ratio of the exterior to the interior diameter of the tube as near as practicable the same for all sections, since the interior pressure for this purpose was assumed to be [illegible] function of the ratio of the inside to the outer diameter. ([illegible] Fig. 3 for these dimensions.)

Without going into too minute descriptions of the deta[illegible] the various accessories, it will be sufficient to explain th[illegible] were designed to produce the interior pressure desired, by f[illegible] into the breech end of the gun, through a stuffing-box pack[illegible] cylindrical steel piston compressing the liquid within the b[illegible] the gun. The design for sealing the bore of the gun agai[illegible] high internal pressure was very simple, consisting of tw[illegible] packings at the breech and muzzle ends respectively. T[illegible] at the muzzle contained a steel valve block for admitti[illegible] hydraulic medium, "Vedol" oil, into the gun from the han[illegible] pump which was used to raise the preliminary pressure t[illegible] pounds per square inch; the breech plug, screwed into the [illegible] of the gun, was fitted with a simple stuffing-box packing th[illegible] which the 4-inch steel piston moves with a relatively small [illegible]tion, compressing the liquid in the gun and producing the desired hydraulic pressure. This limit was determined at intervals, the total pressure required to overcome the friction varying from 18,000 pounds at the beginning to 5000 pounds after a few tests.

The amount of radial expansion was determined by the readings of 11 pairs of Ames dial gauges set concentrically with the gun by means of 11 rings arranged at equal intervals along the gun, and held in position by three spring-bearing screws. The arrangement of the gun and accessories, with reference to the testing machine, is sufficiently indicated in the cut from a photograph taken during the operation (Fig. 4). Readings of these gauges to the nearest ten-thousandth of an inch were made and recorded as the pressure progressively increased or decreased, and

subjected to careful inspection by differences to determine critical points in the progress of radial expansion.

In addition to the gauges the rings carried light wires running parallel to the axis of the gun, for the purpose of indicating by their measured distance from the outside of the tube whether any curvatures of the tube were caused by the internal pressure.

The setting up and adjustment of the many accessories were completed, ready for the application of pressures, December 30,

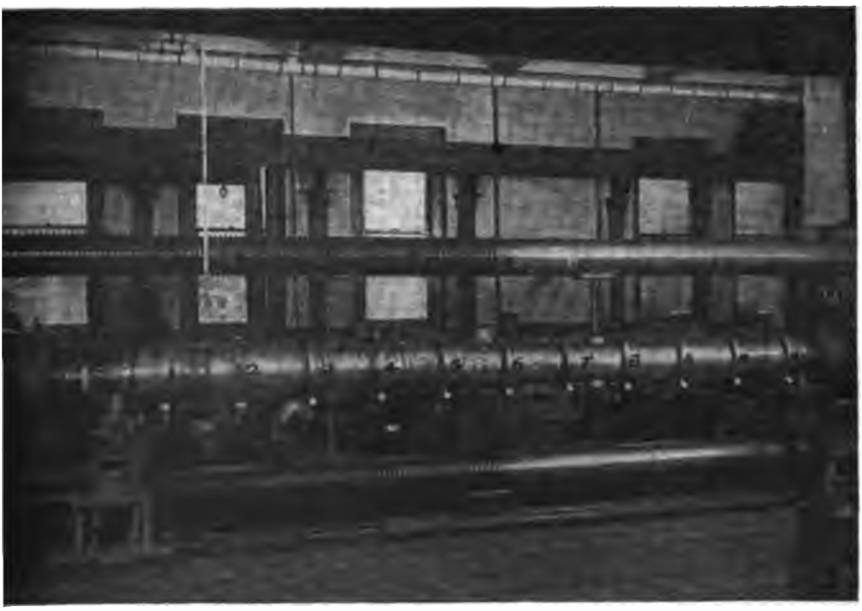
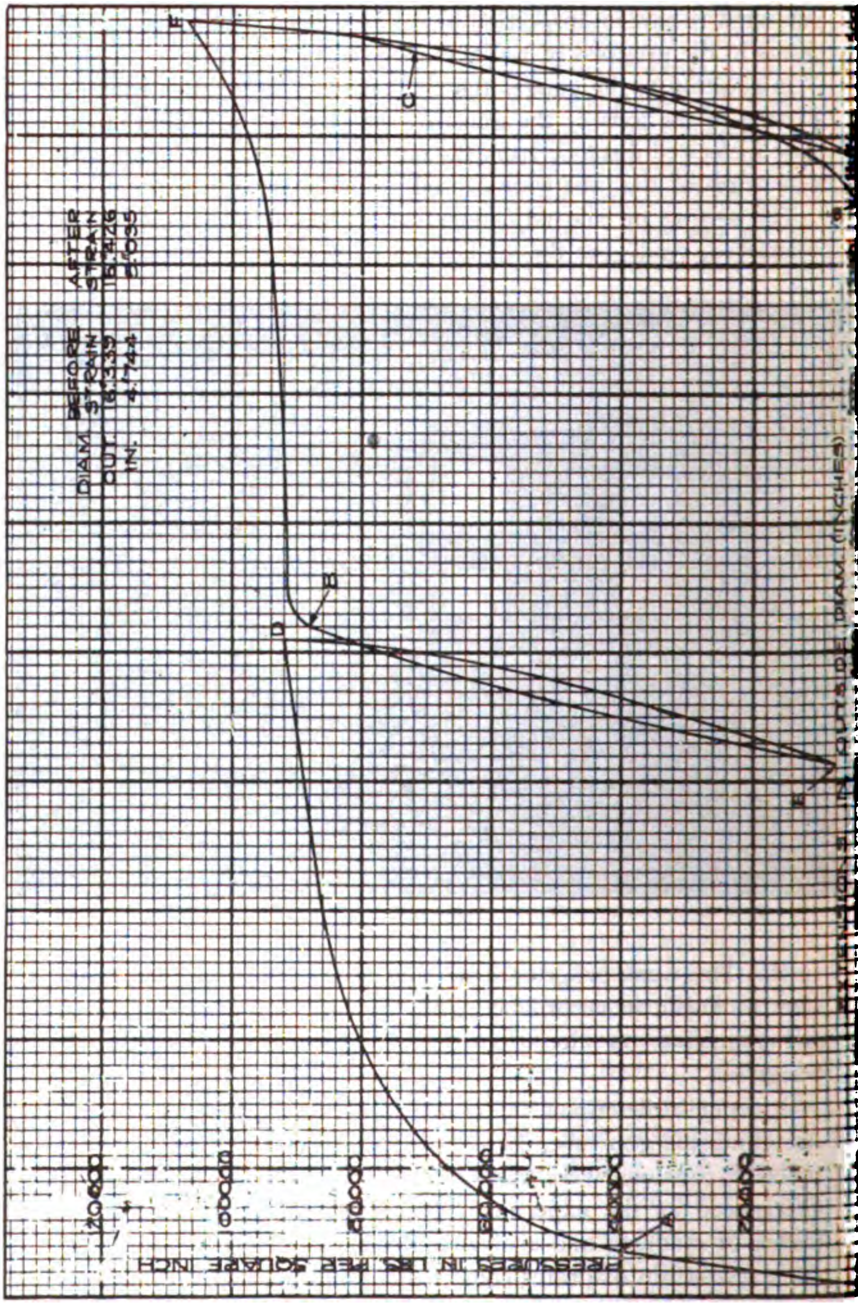


FIG. 4.

1918. The work progressed without accident of any kind from start to finish, in accordance with the carefully arranged plans, and requiring no alterations of the accessories as originally designed.

In order to determine the critical point in the process of cold-stretching the gun tube, the data of pressures and corresponding radial expansions were recorded on large sheets and carefully differenced as the experiment proceeded. A more convenient means of studying and analyzing the data, however, is given by the stress-strain diagrams constructed from the tabulated data at


PRESSURES IN LBS PER SQUARE INCH
120000
100000
80000
60000
40000
20000
DIAM. BEFORE STRAIN AFTER STRAIN
OUT. 16.339 16.426
IN. 4.744 5.035
A
B
C
D
E
F

the conclusion of the work. Three of the typical diagrams are given in Figs. 5, 6 and 7, and for Sections 1, 5 and 8, respectively, which show with sufficient clearness the results of the experiment.

The time element, which is not shown in the diagrams, does not

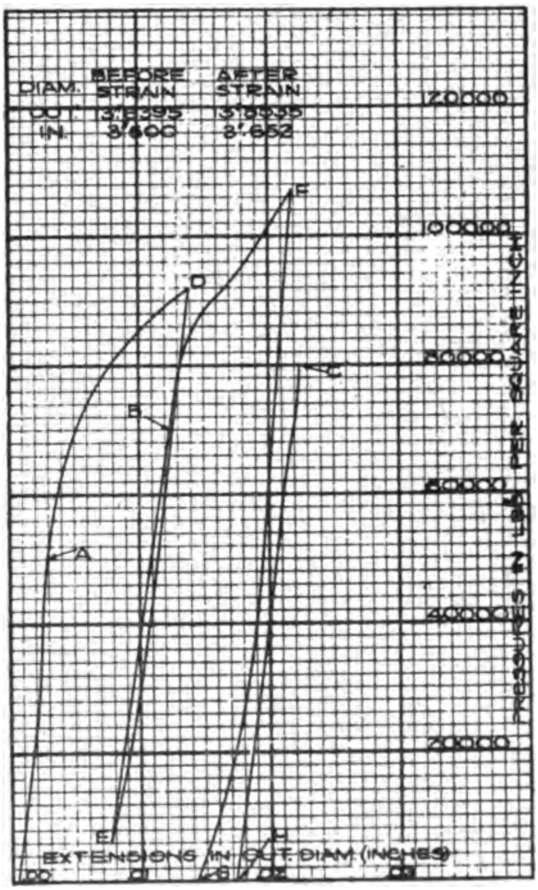


FIG. 6.

play a very important part, but it may be stated here that the application of the progressive pressures began at 9.35 on January 2, and were terminated at 5.15 the same afternoon, when the pressure recorded for the interior of the gun was 92,000 pounds. The pressure was then rather rapidly reduced until at 5.30 p. m.

the gun was without pressure. The following morning, January 3, at 9.45, the pressure was again applied and at 12.15 had reached 107,000 pounds per square inch, the highest pressure employed. This pressure was progressively diminished until at 3.45 the

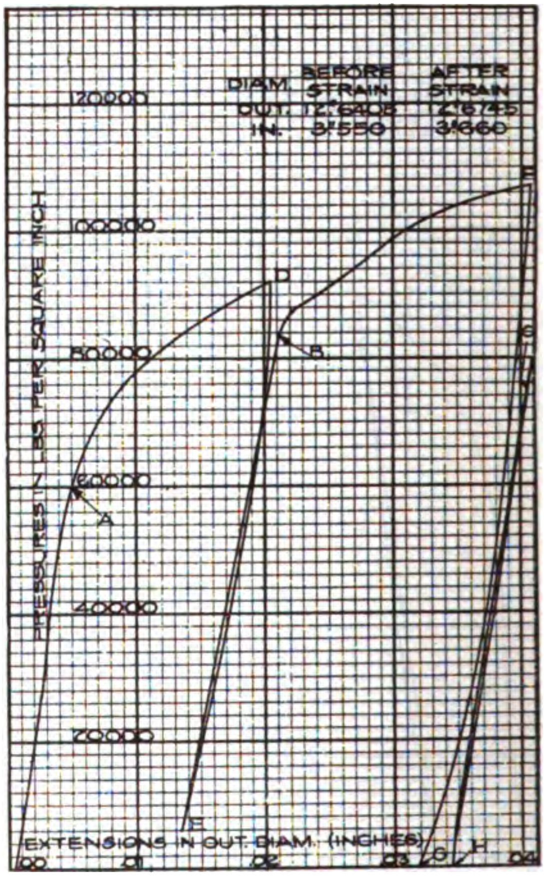


FIG. 7.

pressure was reduced to zero and the oil withdrawn from the interior. Immediately after live steam was introduced and maintained up to a pressure of 15 pounds, giving a temperature of 250° F., and this was maintained until 8 p. m.

In order to test the results of the experiment upon the elastic strength of the gun, pressures were again applied and run up,

progressively to 80,000 pounds, at which point it was indicated that the elastic strength of the gun had been reached.

A study of all the diagrams constructed from the data show very clearly that at the first introduction of pressure the metal of the gun, assumed to have been without initial stresses, worked elastically up to from 40,000 to 60,000 pounds pressures, after which the more rapid expansion shows that the metal was elongating beyond the elastic limit. The amount of temporary and permanent expansion acquired is shown clearly in the diagrams, which also show that when pressure was applied the following day the tube acted elastically up to 80,000 pounds, and that the subsequent permanent elongations given by increasing the pressures up to 107,000 pounds did not apparently give any additional elastic strength. It is plainly indicated that if the heat treatment had been applied at the end of the first expansion, due to 92,000 pounds pressure, the gun would have had all the elastic strength shown in its final pressure test.

At the conclusion of the pressure experiments, the forging was sent to the naval gun factory, where accurate measurements of outside and inside diameters were made, for comparison with similar measures before the cold-straining process. The results of these measurements are given in Fig. 3, a rough drawing to scale of the gun forging. The excess metal of the breech and muzzle sections, about 4 inches long, was cut from the forging, and taken by Mr. Emery to his laboratory at Glenbrook, Conn., for the preparation of specimens, the measurements and tests of which would show the effects of the radial expansion process.

These tests were the more important, as the generally accepted theories of the elastic strength of guns, founded upon the relation of stress and strain within the elastic limit, could not be considered as applying to a case where the greater part of the metal constituting the walls of the gun had been stretched beyond the elastic limit, acquiring a permanent set.

For the purpose of ascertaining the initial stresses introduced in the gun a set of 11 rings was cut from the inner face of the breech and muzzle sections, equally spaced from the interior to the exterior of the gun. The rings, 0.2 inch square section, were cut into the face of the section, and accurately measured across several diameters while still held in place; they were then cut off and again accurately measured. The results of the measurements

from the breech section are shown in Fig. 8 from a photograph of the rings; it will be seen that the initial stresses vary from a tension of 45,600 pounds per square inch for the outer ring, gradually decreasing to zero for the seventh and increasing in tangential compression to 35,300 pounds per square inch for the inner ring. The stress was computed by multiplying the radial

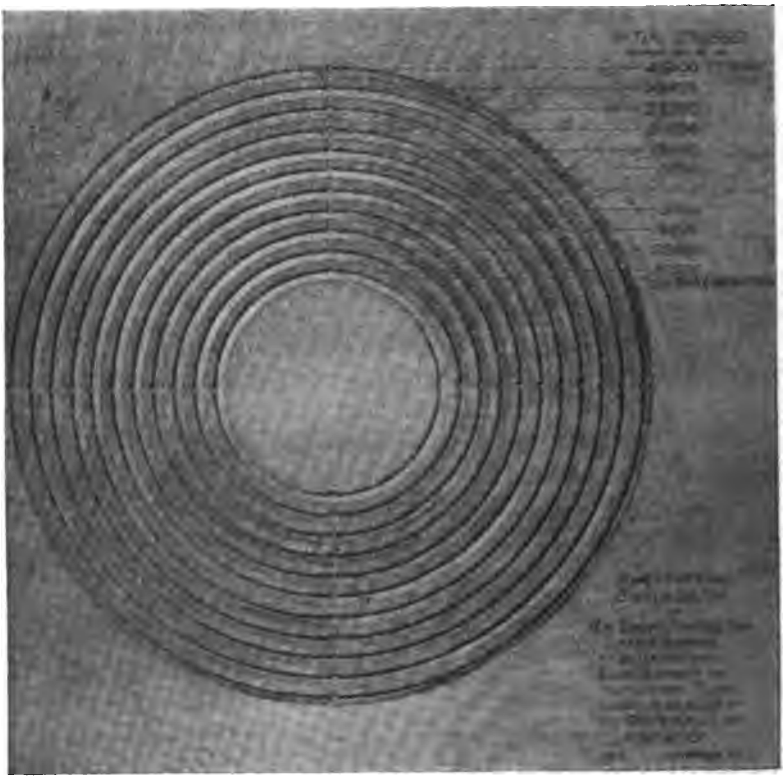


FIG. 8.

expansion of the ring, determined from the difference in diameter before and after cutting off, by the modulus of elasticity, which in the results given was taken to be about 28,500,000.

For the muzzle section the outer and inner rings measured as follows:

Before cutting—outer ring	12.560	Inner ring	4.000
After " " "	12.543	" "	4.0062
Difference	.017	....	—0.0062
Initial tension	+38,600	....	—44,300

In order to determine the effect of cutting down the muzzle section to dimensions of finished gun, the extra metal was turned off the exterior, and a representative section thus obtained 3.8 inches long, by 7".8013 outer and 4".0034 inner diameter, respectively. From this outer and inner test rings were cut 0.2 wide by 0.1 thick (measured radially), and the measurements resulted as follows:

Before cutting—outer ring	7.8013	Inner ring	4.0034
After " " "	7.7942	" "	4.0070
Difference	.0071	....	—.0036
Initial Tension	+26,000	....	—25,700

The two test rings of the size of the finished gun at the muzzle were for the purpose of determining beyond question that the metal of the cylinder walls, after cold stretching, is in a condition of initial strain represented by an infinity of hoops with just the right amount of shrinkage to give the maximum elastic strength; and that the removal of metal from the outside or from the inside leaves the remainder in a proper state of initial strain. It may be noted in the same connection that the inner ring of the breech section, shown in the preceding paragraph, is 5½ inches in diameter, approximately the dimensions of the finished powder chamber section.

The initial strains found in the various rings cut from both sections show that the metal of the finished gun is in an ideal condition of initial stress, varying progressively by infinitesimal graduations from 25,700 to 35,300 pounds per square inch tangential compression at the interior layer of the bore, to from 26,000 to 45,000 pounds tangential tension at the exterior layers. As these stresses vary progressively from compression at the interior to tension at the exterior, it is evident that the process has resulted in a condition of self-hooping in which the hoops are the successive infinitely thin layers from exterior to interior, each one shrunk upon the one next interior with a shrinkage such that all the layers (hoops), under the maximum interior pressure design, reach their elastic limit in tension together.

The initial strains thus shown are most satisfactory, not only in respect to distribution but also in respect to the amount.

The improvement in the quality of the metal is equally apparent from an examination of results yielded by test specimens taken

from the forging before and after the application of the process. These were taken from breech and muzzle sections, tangentially in planes at right angles to the axis and at such distance from the center as to have the 0".505 square sections shown as closely as possible the quality of the metal at the bore, the middle and the outside. The testing was carefully done in each case on an Emery testing machine, taking extensometer readings in ten-thousandths of an inch for the extension under load. In the following table are given the elastic strength E and the ultimate strength R in thousand pounds per square inch:

	E		R	
Specimens	Before	After	Before	After
Muzzle, outside	60	65	94	97.5
Muzzle, middle	57.5	62.5	94.5	96
Muzzle, inside	62	72	95	105
Breech, outside	56	64	91	100.5
Breech, middle	52	55	91	89
Breech, inside	40	65	91	94

The inside specimens, having experienced the greatest permanent elongation, show the greatest improvement; their stress-strain diagrams are shown in Fig. 9, where the greatest elastic strength belongs to the specimens after cold working.

At the naval gun factory the gun was given the usual finishing and rifling of the standard 4-inch guns of the same type. After mounting on the standard mount for this type of gun, it was sent to the Naval Proving Ground for test firings early in March, 1919. In order to furnish comparison with the best type of standard 4"/50 gun, the firings were to be carried on in conjunction with a standard Mark IX-5 gun No. 3479, made by the American & British Manufacturing Company, Bridgeport, Conn. In the inspection of the two guns previous to the firing, by members of the Special Board on Naval Ordnance, it was noted that rifling of the Emery guns was much rougher in appearance than that of the standard gun, and had several small gouges and evidence of tool chattering in the rifling, while that of the standard gun was very smooth and highly polished.

Investigation in the gun shop disclosed that the rifling of contract guns in general is admitted to be superior in appearance to rifling done in the gun shop, but not in efficiency. This is due to the fact that the gun shop does not put in the time on the operation that outside contractors do, since it has been determined that

a lesser polish is satisfactory for service purposes. Normally, the gun is lapped after rifling by both a lead slug and a copper slug, which are forced into the rifling by spring pressure. It is the copper lapping which puts on the final brilliant finish, and in the

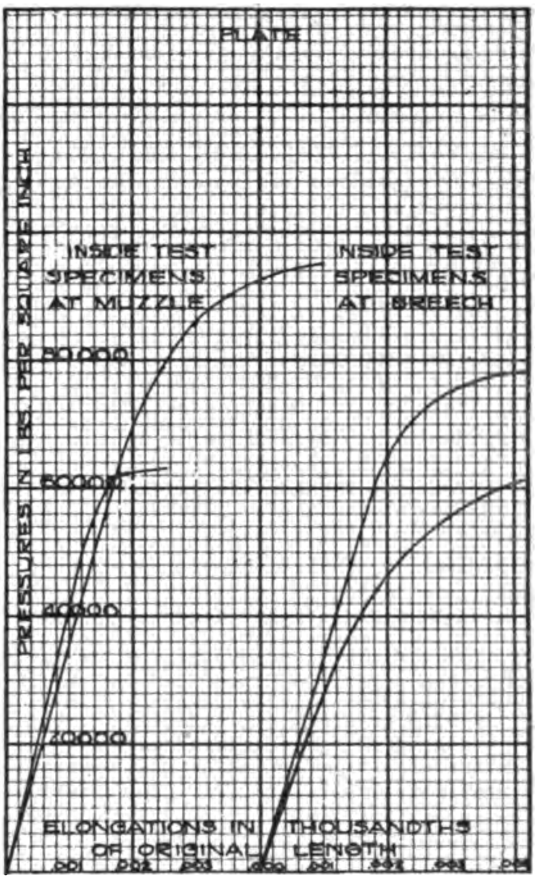


FIG. 9.

case of the Emery gun the urgency of the order made it seem expedient to the gun shop to omit the copper lapping and lap out only with the lead slug.

Further inquiry brought out the information that representatives of the American & British Ordnance Company, the manufacturers of the standard gun noticed above, had stated that they

had found great difficulty in satisfactorily machining gun forgings made by the Tioga Steel & Iron Company; that they had tried varying the speed of the lathe, together with the temper and hardness of the tool used, and that, notwithstanding their best efforts, the machined gun forgings of this company always had a rough appearance. It would seem, therefore, that the rough appearance noticed in the rifling of the 4-inch Emery gun was due partly to some characteristics of this steel.

It is further to be noted, in connection with the quality of the steel employed in the construction of this gun, that the microscopic photographs of sections taken from the gun forging, both before and after straining, show a marked difference in the granular appearance of the steel between the Tioga Steel & Iron Company forging and a properly heat-treated specimen, indicating that the forging had been over-heat treated.

Both guns were star-gauged before the test, and after every 60 rounds thereafter. The first star-gauging measurement brought out a further imperfection in the Emery gun, its diameter being larger by .021 inch at the origin of the rifling.

Emphasis is laid on these relative imperfections of the Emery gun, as the theory of the process indicates not only improvement in elastic strength but in other qualities of the metal, especially at the interior of the bore, which on account of the high compression to which the interior is subjected ought to offer greater resistance to erosion.

The firing test of the two guns was continued from April 16 to about September 1, 1919, on which date each gun had fired 599 rounds; the following measurements give the enlargement in thousandths of an inch at and near the origin of rifling, resulting from careful star-gauge measurements made after the completion of the endurance tests:

Emery	Distance from breech	Standard
136	42.13	161
136	42.25	154
128	43.13	139
71	52.00	77

A visual inspection of the bore of the two guns shows the lands at the origin of the rifling nearly worn away for about 8 inches or a foot. At the muzzle, however, the lands are still in serviceable condition, although the gouges and tool markings in the

rifling of the Emery gun still persist. Both appear still fit for further service, especially when compared with a standard Mark IX-5 No. 1302, in which, after 544 rounds, the lands are almost gone throughout the bore from origin to muzzle.

The extent to which the accuracy life of the guns has been reduced may be inferred from the results of firing the last five rounds of the series, using A & B shell, in comparison with a new Mark IX-5 standard gun:

Gun	Velocity	Pressure	Range
Emery	2759 = 13	14.32 = .33	9215 ± 90
Standard	2768 = 25	14.61 = .24	9225 ± 98
New	2862 = 11	16.43 = .21	9522 ± 40

The loss of about 100 f. s. in velocity, two tons in maximum pressure, and 300 yards in a range of 9500 yards, would not preclude their further use, although the accuracy of fire is considerably less.

Notwithstanding the further endurance indicated for both guns, it was decided to make thorough star-gauging and taking of impressions of their bore at the naval gun factory, where they were sent on September 11, 1919; and upon the completion of this work to subject them to high-pressure firing for the purpose of testing the apparent superior elastic strength of the gun constructed by the Emery process. The design of the standard gun calls for a maximum elastic strength of 56,000 pounds, while the construction of the Emery gun shows that it should have a maximum elastic strength of 80,000 pounds. As these tests may be somewhat delayed, permission has been given by the bureau to publish a brief description of the process.

During the progress of the experiments resulting in the construction of these guns, the general principles of the proposed method, as well as the various practical questions involved, were examined and discussed at length by the Special Board on Naval Ordnance, to which were added the superintendent and other officials of the naval gun factory, as well as officers of the bureau and the Naval Proving Ground, having general experience and knowledge of the subject of gun construction.

The conclusions of the board, unanimously adopted at its last meeting on March 5, 1919, recommended the immediate construction at the naval gun factory of type 6″/53 guns, utilizing the facilities at the Bureau of Standards, and at the same time the

development of plans for installation of the necessary facilities at the naval gun factory for construction of guns of this type as well as larger guns. The Bureau of Ordnance has approved these recommendations and has adopted for the official designation of the process the name of "Radial Expansion."

A brief historical résumé of the basic principles involved in the proposed method will show that it is not such a startling innovation as might be imagined from the description of the two experiments already described. These principles are:

1. Special elastic strength induced by cold working.

2. Fixing or ageing of the increased elastic strength by a mild-heat treatment after cold working.

3. Radial expansion; resulting in a condition of initial strains, which are only partially realized in the methods now in general use; that is, shrinking on jackets and hoops previously expanded by heat, or wire winding.

1. *Special Elasticity.*—The development of a special elastic strength in metal by cold stretching was first definitely demonstrated and announced by Colonel Rosset, as a result of experiments at the Turin Gun Factory in 1874, upon test specimens cut from Petin-Godet hoops and other selected specimens of steel for gun construction. A summary of these experiments is contained in "Notes on Construction of Ordnance" (Army Ordnance Bureau No. 11), published in 1882. The results showed that if a test bar be subjected to a tensile stress greater than its limit of elasticity, it will not undergo, when subjected to a subsequent stress less than the above, any permanent elongation and, therefore, its elastic power has been increased. It was further indicated by the great regularity in the elastic elongations, and their proportionality to the stresses, that this special elasticity might be increased with the increase of the stresses nearly up to the point of rupture.

A clear idea of this development of *special elasticity* will be readily appreciated from the stress-strain diagram of test specimens subjected to cold stretching. When a test bar is subjected in a testing machine to a gradually increasing tension, there is a measurable elongation of the bar at each increment of tension, which is proportional to the tension until the *elastic strength* of the metal is reached. Within this limit, if at any instant the tension is removed, the bar recovers wholly its original dimensions.

If the tension and corresponding elongation are plotted, the former as ordinates and the corresponding elongations per unit of length as abscissæ, the resulting diagram will be a straight line, up to a certain point defined as the elastic limit, as illustrated in Fig. 10, in the sections *OA, OB* and *OC;* but as the load is gradually increased beyond the elastic limit, this regularity of behavior suddenly ceases, the elongation for a given increment of tension increases more rapidly than the tension, and if the load is now removed the bar contracts somewhat, but is not restored to its

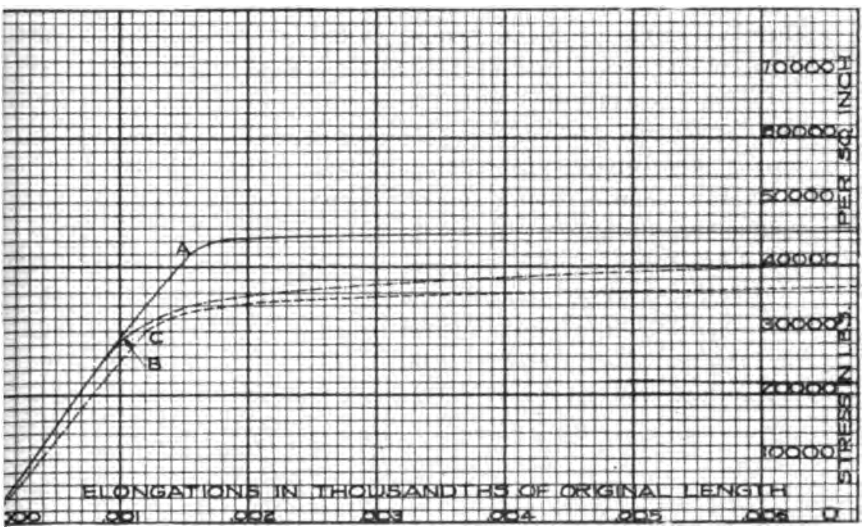


FIG. 10.

original dimensions—it has acquired a permanent elongation or set.

If the bar, after a period of repose, is again subjected to the load which resulted in the permanent set, it will be found that the elastic limit of the specimen has been increased—that the constant ratio of load to elongation will hold up to the load which produced the permanent set.

The dotted curve *B,* from Colonel Rosset's data, is formed from the mean values of stress and corresponding elongations of several specimens which were subjected to loads leading to rupture. Other specimens of the same material were subjected to a stress sufficient to cause a permanent elongation, and the increase

in the elastic limit of these specimens is shown in curve *A*, by the increase of the ordinate for the point *A* over that of the point *B*.

As these experiments were conducted for the purpose of studying the best method of constructing built-up guns, Colonel Rosset naturally inquired if the same results, in regard to special elasticity, would be obtained with specimens in which the permanent set had been produced by elongations due to heating and subsequent cooling, the contraction being restrained in order to produce the permanent set. The explicit problem was to determine if the contraction due to cooling of a heated hoop upon an interior tube, thereby introducing initial strains in the hoop and tube, would result in increased elastic strength as in the case of cold stretching.

Curve *C* corresponds to curve *A*—in *A* the special elasticity induced by cold stretching, in *C* the corresponding permanent set having been produced by heating and restrained contraction. It is evident at once from a comparison of the two diagrams that neither the elastic strength nor the ultimate strength of the latter metal has been favorably affected.

His conclusions, in regard to the general subject, especially with reference to built-up guns, in which the jacket or hoop is expanded by heat and contracted upon the interior members, are so important that they are quoted:

> From these experiments it may be inferred that the elastic power is not increased by a tensile strain, when that strain is obtained by expanding the specimen by heating, and restraining the contraction consequent on cooling; . . . .
>
> Wishing to develop the elastic power in order to obtain greater elastic elongation, it will be necessary to have recourse to mechanical tensile strains, and not to the method of restraining the contraction consequent on cooling.

In Fig. 11 is illustrated the effect of cold stretching upon the development of *special elasticity* in the case of two specimens of mild steel tested by Mr. A. H. Emery. These two diagrams are selected from a large number of similar ones, the results of Mr. Emery's experiments made on the bridge links used in the construction of the St. Louis Bridge. The diagram shows that in the dotted curve the metal reached the elastic limit at the point *F*, corresponding to about 40,000 pounds of tension, and began to show the more rapid elongation beyond this point up to *G*, 46,000 pounds, when the load was removed. The permanent elongation

for this load was about .009 per linear unit. After a brief period of time, the load was again applied and the strength line *H-I* shows that the limit of elastic strength has been increased up to the stress which produced the permanent set. From that point on the metal gradually elongates, and rupture takes place at 77,300 pounds. In the second diagram the elastic limit was reach at a slightly lower point, and the load was continued with the elongations indicated up to the point *C* at 62,000 pounds per square inch, with momentary elongation of .0413 and a permanent elongation

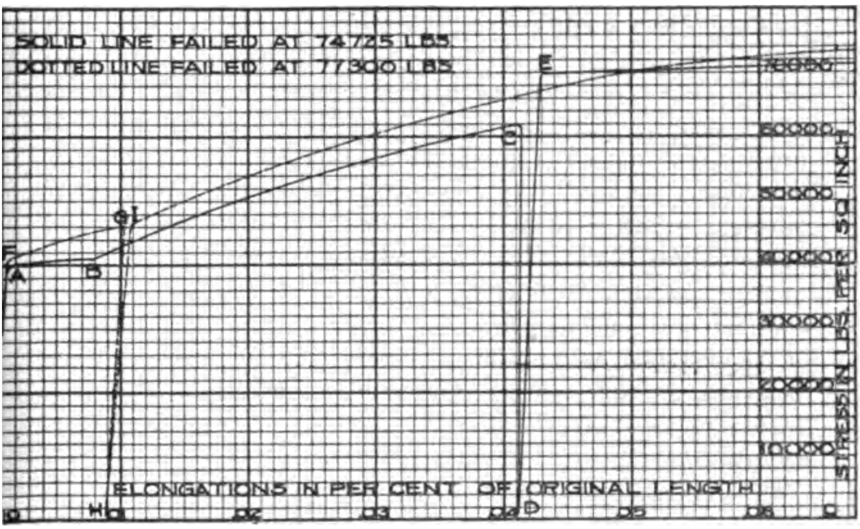


FIG. 11.

of .040. In this specimen the load was allowed to remain for a period of a week, when it was removed; upon the gradual application of the load, the curve clearly shows the increased elastic limit up to 70,000 pounds.

2. *Tempering or Ageing.*—The question of the permanence of the special elasticity induced in steel by cold working has been a subject of much experimental investigation during the past 25 years. Some investigators have claimed, notably Prof. J. B. Johnson, of the University of Wisconsin, that the gain in special elasticity, due to tension, is accompanied by a loss of elasticity in compression. These conclusions are stated in a text-book for engineers recently published by Professor Johnson, under the

title "The Materials of Construction, a Treatise for Engineers on the Strength of Engineering Material," wherein he stated:

Both wrought iron and rolled steel, in their normal state, have "apparent elastic limits" in tension and in compression numerically about equal. If this material be stressed much beyond these limits, however, in either direction, its elastic limit in this direction is numerically raised to about the limit of its greatest stress, while the elastic limit in the opposite direction is greatly lowered or even reduced to zero.

In the specifications of Mr. Emery's patent, it was claimed that the gain in elastic strength by cold stretching could be rendered permanent by a mild-heat treatment, the claim being based upon the result of numerous experiments establishing this principle; an examination of numerous diagrams of these early experiments shows that the claim was well founded. Confirmation of his results are contained in a long and carefully conducted series of experiments by Prof. J. A. Van Den Broek, at the University of Michigan, which were published in the "Journal of the Iron and Steel Institute," at London, England, May, 1918.

These experiments show that metal, strained beyond the elastic limit, requires some time in which to recover from the disturbance of the molecular or crystalline structure; but this recovery of the metal may be accomplished by a mild-heat treatment from 100 degrees to 300 degrees centigrade, which seems to render permanent the condition introduced by cold straining.

His statement of conclusions is so important that they are quoted below without change. He first distinguished the several kinds of cold working, and the resulting special elasticity as being of different *direction* and *sense, i. e.,*

Tension and *compression, same direction*
Tension and *compression, opposite sense.*
Positive torsion (+shear), *same direction.*
Negative torsion (−shear), *opposite sense.*
Torsion and *tension,* respectively, of *different directions.*

(1) When mild steel is cold-worked and properly aged or tempered, and subsequently tested in the *same sense* as that of cold working, its elastic limit may be raised more than 100 per cent and from 10 per cent to 20 per cent beyond the stress at which cold working was discontinued.

(2) When mild steel is cold-worked in one *direction* and properly aged or tempered, but tested in either one of two senses of a different direction, then its elastic limit may be raised some 50 per cent.

(3) When mild steel is cold-worked in one sense and properly aged or tempered, but tested in the opposite sense, then the elastic limit remains at the value of the original elastic limit, but the yield point is raised.

(4) When mild steel is cold-worked in any direction or sense, without *ageing* or *tempering,* then the elastic limit falls below the value of the original elastic limit, often down to zero.

(5) Tempering cold-worked steel at temperatures from 100° C. to 300° C., or ageing it, has a tendency to perfect its elastic properties. Tempering merely accelerates the effects of time.

3. *Self-Hooping Due to Radial Expansion.*—The first reference to the subject of cold-stretching a cylinder beyond the elastic limit, in order to realize the initial strains due to the subsequent contraction upon the release of the pressure, appears to be contained in the second volume of "*Limite D'Élasticité et Résistance a la Rupture,*" by Captain Charles Duguet, published in 1885.

In the study of the ordinary method of built-up guns by hooping, he was led to consider the means of attaining a "cylinder of equal resistance," defining it as one in which each layer of the cylinder, under the maximum load within the elastic limit, should be brought at the same instant to its limit of elasticity. Such a cylinder would have a greater resistance than any other cylinder of the same dimensions and weight of metal.

The method of wire-winding approached this idea, but a more perfect realization could be obtained by cold-stretching a given cylinder of homogeneous material, by the application of increasing interior pressure until each concentric layer had acquired a permanent deformation up to the outside layer, which would be stretched just to its elastic limit. He assumes, in the dilatations of such a cylinder, as in all deformations of a non-porous solid, in which the density varies very little, that we may consider the volume constant without any appreciable error, so long as the dilatations do not exceed 0.03 per unit length. As a result of this assumption, the relative dilatations of the various layers are inversely proportional to the square of the radii, or

$$R^2 \frac{\Delta R}{R} = r^2 \frac{\Delta r}{r}.$$

He describes clearly the elastic resistance of such a tube primitively deformed:

When a tube has been sufficiently deformed by an interior pressure P_0, the elastic limit is passed at every one of its points. If the pressure ceases to act the tube is deflated, contracts upon itself; but the total deformations pro-

duced in the different layers being nowhere proportional to the elastic forces which accompanied them, all these forces cannot vanish at the same time; the exterior layers remained stretched and exert upon the interior layers a radial pressure; inversely, the interior layers react upon the others and are compressed tangentially, just as happens in a hooped cylinder. Under these conditions, a new pressure inferior to P_0 will produce only elastic deformations. . . . .

Under the new action of the pressure P_0, each layer suffers a deformation corresponding to its actual elastic limit; and p and t being the pressure and principal tension developed at any point whatever, we shall have at each point the following relation:

$$mp + nt = G.$$

G, which depends upon the initial deformation, varies from one point to another and diminishes from the exterior to the interior.

In his theory of the resistance of metals, G is defined as the coefficient of "shear" (sliding, *glissements*), and is approximately six-tenths of the elastic limit of the metal for simple traction:

The interior pressure capable of deforming a tube so that the exterior layer shall be just at its elastic limit E is certainly superior to

$$P_0 = \frac{nE}{n-m}\left\{\left(\frac{R_1}{R_0}\right)^a - 1\right\},$$

but it differs from it very little; for, at each point, even at the interior layer, the deformations produced are so small that the elastic forces developed are very little different from those which correspond to the natural limit of elasticity.

In the formula above quoted, n is equal to 0.59, m is equal to 0.41, and a is equal to 0.3. He applies his formula to an unstrained cylinder and to the same cylinder which has been strained as above described.

Let us take as an example a steel cylinder of one caliber thick, in which the metal has an elastic limit of 30 kgs. in simple traction. The natural elastic resistance is P_0 equal to 1580 atmospheres; every pressure superior to this will produce a permanent deformation. A pressure slightly superior to

$$P_0 = \frac{18k}{0.18}\left\{3^{0.3} - 1\right\} = 39k,$$

per square millimeter, say about 4000 atmospheres, will produce permanent deformations at every point and leave the exterior layer stretched just to its natural elastic limit; its elongation will be

$$\frac{E}{M} = \frac{30}{20{,}000} = 0.15\%;$$

the interior layer will suffer under the same pressure a dilatation nine times as great, or 1.35 per cent.

Thus, by a simple initial interior dilatation of 1.35 per cent, produced solely by interior pressure, we will increase the elastic resistance of a soft-steel tube one caliber thick from 1600 to 4000 atmospheres and we will obtain thus a cylinder more resistant than any other hooped cylinder of the same material and the same dimensions, as we have realized the solid of perfect equal resistance already defined.

The assumption of Duguet, given in the preceding paragraphs for the relations of the pressure and resulting tension at any point in a hollow cylinder, is equivalent to

$$t+0.7p=E,$$

where E is the initial elastic limit of the metal before cold working.

Beginning in 1909, extensive investigation of the subject has been made at the Central Laboratory of the French Navy, under the name of "*Autofrettage,*" literally self-hooping or auto-hooping. The mathematical theory of "*Autofrettage*" has been developed by Ingénieur-Général L. Jacob, and very recently published in a two-volume work entitled "*Résistance et Construction des Bouches à Feu, Autofrettage.*" He assumes that the elastic limit at any point is reached when the relation of the interior pressure and the resulting tension is

$$t+0.3p=E,$$

and calls attention to the fact that the theory of Duguet gives too small an amount for the maximum resistance of a cylinder which has been built by the process of autofrettage.

He also notes, further, that the adoption of the theory that the elastic limit of the metal is reached when at any point

$$t+p=E$$

leads to a still smaller resistance for a given cylinder.

The latter assumption is the basis of the mathematical investigations of Colonel Malaval, under whose direction the experimental work at the Central Laboratory of the French Navy has been carried on.

Each of these eminent authorities appears to establish the correctness of his respective theory upon the result of experiments and investigations made at the central laboratory. Both, however, call attention to the fact that the pressure of autofrettage is limited to such a pressure that, upon the return of the stretched cylinder to a state of rest, there shall not be developed any new permanent deformations in the interior layer.

Whichever theory is elected, the permissible pressures are considerably less than those to which the Emery gun was subjected. The examination of the initial strains of the rings cut from the metal of the Emery gun apparently does not furnish a complete criterion in this respect. If there has been introduced new permanent deformations in the interior layers upon the return to rest, they do not appear to be indicated by the intial strains found in the 24 test rings.

It is not intended in this description of the construction of the two experimental guns to discuss or to develop the mathematical theory of the elastic strength of guns constructed by the method of radial expansion, which will necessarily be deferred until the basic assumptions are more definitely established by experiment, nor is it necessary to do this in order to utilize the method in the experimental construction of either single-piece or built-up guns of several hoops and tubes.

In the design of guns to be constructed by this method, the elastic-strength curve is determined from the powder-pressure curve, just as in standard guns now in use; whether the gun shall be a single piece or a compound gun will be determined by the size of the forging which it is practicable to make from a metallurgical standpoint, and convenience in the machining of the gun. From the theoretical standpoint, the construction of a 16-inch gun should offer but few difficulties outside those to be expected in a smaller single-piece gun. The various parts are machined to a close fit with as little play as possible, the parts are assembled and the pressure is applied just as would be done with a smaller single-piece gun, as the pressure necessary to realize the elastic strength desired is a comparatively simple function of the ratio of the inside to the external radius.

Sufficient experimental work has already been carried out at the naval gun factory to demonstrate that the pressure plant installation can be constructed in a convenient form and at a relatively small cost, as the extensive experiments conducted at the French Naval Laboratory, under Colonel Malaval, have shown that all the elastic strength desirable can be obtained by pressures giving a permanent deformation of the interior layer not exceeding .03; an amount very much smaller than was experienced in the case of the Emery gun, due to the attempt to carry out the process by stretching the whole gun with the same pressure for all sections.

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GRAPHICAL METHOD FOR REDUCING LATITUDE SIGHTS TO MERIDIAN

By RICHARD D. FAY

The alignment chart here given furnishes a simple means for working an ex-meridian sight graphically. The theory on which this method is based is the same as that given in Bowditch's Navigator, and the work performed with the chart is the same as that done with tables Nos. 26 and 27 in Bowditch. The advantages of the graphical method are that the work may be done more rapidly and with equal accuracy (no interpolation being required) and that the degree of precision which is possible with any data can be estimated at a glance.

The theory of the method is as follows:

Let

Z = Zenith distance of body.
d = Declination of body.
L = Latitude of observer.
t = Hour-angle of body.

The fundamental relationship between these quantities is

$$\cos Z = \sin d \sin L + \cos d \cos L \cos t.$$

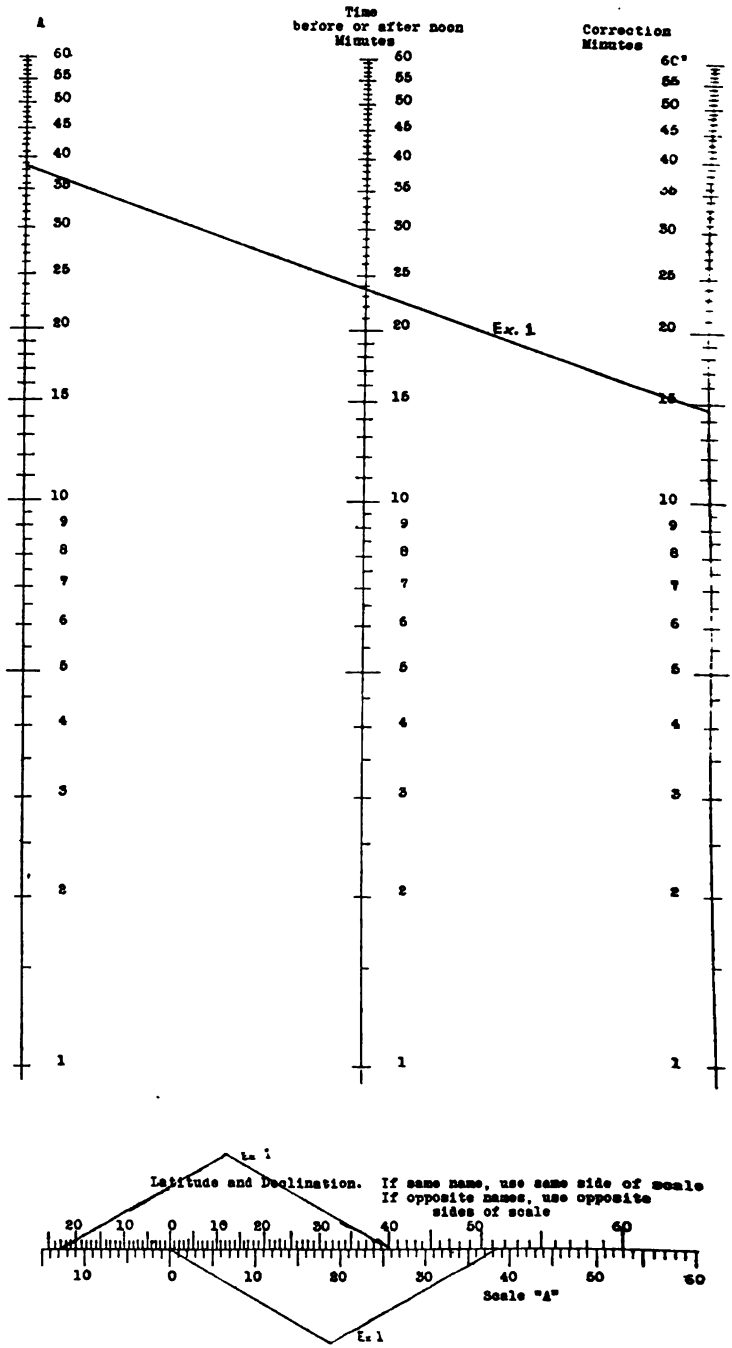
When $t=0$ (*i. e.*, when the body is on the meridian),

$$\cos Z = \sin d \sin L + \cos d \cos L = \cos(L-d);$$

or,

$$Z = L - d = \text{meridian zenith distance.}$$

The function of the ex-meridian method is to make use of this extremely simple relation when the observed body is near but not on the meridian. It is necessary to know t at least approximately as will be shown, but since modern practice recommends


A
Time
before or after noon
Minutes
Correction
Minutes
60
55
50
45
40
35
30
25
20
15
10
9
8
7
6
5
4
3
2
1
Ex. 1
Ex 1
Latitude and Declination. If same name, use same side of scale
If opposite names, use opposite sides of scale
20 10 0 10 20 30 40 50 60
10 0 10 20 30 40 50 60
Scale "A"
Ex 1

calculating the time of the meridian passage rather than taking the greatest observed altitude, the ex-meridian sight requires no extra work except that performed on the chart, which can be done in about 10 seconds.

If Z_0 = meridian zenith distance $= L - d$.

Z = zenith distance found from observed altitude.

Then the "reduction," R, to be applied to the observed altitude is $Z - Z_0$.

Since

$$Z = Z_0 + R,$$

$$\cos(Z_0 + R) = \sin d \sin L + \cos d \cos L \cos t;$$

or,

$$\cos Z_0 \cos R - \sin Z_0 \sin R = \sin d \sin L + \cos d \cos L \cos t.$$

This relationship involves no approximations.

When, however, t is small, R also must be small, so that

$$\left.\begin{array}{ll} \cos R = 1 & \text{(approximately)} \\ \sin R = R & \text{"} \\ \cos t = 1 - \dfrac{t^2}{2} & \text{"} \end{array}\right\} R \text{ and } t \text{ in radians.}$$

$$\therefore R = \frac{\cos Z_0 - \sin d \sin L - \cos d \cos L + \cos d \cos L \cdot \dfrac{t^2}{2}}{\sin Z_0} \text{ (approx.).}$$

Substituting for Z_0 its value, $L - d$,

$$R = \frac{\cos(L-d) - \cos(L-d) + \cos d \cos L \cdot \dfrac{t^2}{2}}{\sin L \cos d - \cos L \sin d}$$

$$= \frac{t^2}{2(\tan L - \tan d)}.$$

If R is expressed in minutes of arc and t in minutes of time

$$\left(\frac{\pi}{180} \times \frac{1}{60}\right) R = \left(\frac{\pi}{180} \times \frac{15}{60}\right)^2 \frac{t^2}{2(\tan L - \tan d)};$$

or,

$$R = \frac{t^2}{\dfrac{96}{\pi}(\tan L - \tan d)};$$

or,

$$R = \frac{t^2}{A} \text{ where } A = \frac{96}{\pi}(\tan L - \tan d).$$

The two operations necessary to find the reduction of altitude are then (1) to find A which is the reciprocal of reduction when $t=1$ minute. This involves L and d; (2) to find reduction from A and t.

The graphical method for finding A is simply to scale off the difference between two tangents on a modified scale.

The alignment chart is arranged to give R as follows:

Since

$$R=\frac{t^2}{A},$$

$$\log R=\log t^2-\log A;$$

or,

$$\log t=\frac{\log R+\log A}{2}.$$

That is to say, $\log t$ is the average of $\log R$ and $\log A$. If a straight line intersects three vertical lines spaced equally, the intercept on the inner line measured from any horizontal base will evidently be the average of the intercepts on the outer lines measured from the same base. Therefore, if three lines with equal logarithmic scales be used, the outer lines representing R and A, and the inner one t, corresponding values of R, t, and A will always lie on a straight line. Hence R is readily found when t and A are known.

The procedure in using the alignment chart is as follows:

I. To find A. With the dividers on the upper horizontal scale take the distance between the latitude and declination (approximate values) on same side of zero if they are of the same name or on different sides if they are of different name. This distance measured on lower horizontal scale gives A.

(Alternative method: Find numbers on lower horizontal scale opposite latitude and declination on upper horizontal scale. If L and d are of the same name find the difference of the numbers; if of different names find the sum of the numbers. The result will be A.)

II. From position by dead reckoning calculate the watch time of meridian passage. To insure taking the sight within the time interval that this method holds good, plan if possible to take the sight so that the time interval t in minutes does not exceed A.

Place a straight-edge across the vertical scales to intersect left-hand scale at A and middle scale at t. The intersection with the right-hand scale will give the required reduction in minutes of arc.

Example I.—January 2, 1920, in Lat. 40° N., Long. 45° W. (position uncertain) corrected central altitude of sun was 27° 00′ at G. M. T. $2^h\ 40^m\ 00^s$.

	h	m	s	
G. M. T.	2	40	00	
Eq.		−3	43	
G. A. T.	2	36	17	(Jan. 2)
Long.	3	00	00	(West or −)
L. A. T.	23	36	17	(Jan. 1)
	24	00	00	
t		23	43	say 23¾ min.
Decl. (d)		22	59.8	S

With dividers: 40 to right of zero and 23 to left of zero gives $A = 38\frac{1}{2}$.

With straight-edge: Line through 38½ left and 23¾ center gives 14⅝ right.

$R = 14.7'$.

Ex-merid. alt.	27°	00′	
R		14.7	
Merid. alt.	27	14.7	
	90	00.0	
Z	62	45.3	N.
d	22	59.8	S.
L	39	45.5	N.

If A had been found using this value for L, A would have been about 38.4 which gives R very little change. Also, by moving the straight-edge keeping A 38½ it will be seen that a variation in t of one minute produces a change in R (and hence in L) of less than 1½ miles. Therefore, for this example where A is large there is little difficulty in getting accurate results. Actually if no approximations are used, the latitude is found to be 39° 45.6′, a difference of only 600 feet.

Example II.—January 2, 1920, in Lat. 30° S., Long. 45° W. by account corrected central altitude of sun 81° 50.6′ at 2^h 47^m G. M. T. From data of previous example:

$$t = 16^m\ 43^s.$$
$$d = 22\quad 59.8\ \text{S.}$$

With dividers: From 30 to 23 both to right of zero gives $A=4.8$.

With straight edge through $A=4.8$ and $t=16\frac{3}{4}$, R is found (with difficulty) to be about 59′, very slight changes in either A or t making large changes in R.

Ex-merid. alt.	81°	50.6′	
R		59.0	
Merid. alt.	82	49.6	
Z	7	10.4	S.
d	22	59.8	S.
L	30	10.2	(True L is 30° 14.8′)

If A is corrected by using this value for L, the error will be reduced to about 2′, but there is considerable uncertainty in the method still.

If now another sight be taken when $t=5^m$; corrected alt. becomes 82° 40.0′.

R (using $A=4.8$) is found to be 5.2.

Obs. alt.	82°	40.0′	
R		5.2	
Merid. alt.	82	45.2	
Z	7	14.8	S.
d	22	59.8	S.
L	30	14.6	S.

which is within the ordinary error of observations.

For a star sight the ex-meridian method is of particular importance since it is unusual to have a good horizon for more than a short time when the stars are visible. The hour-angle t is then the difference between the right ascension (R. A.) of the star and the local sidereal time. In other respects the procedure is the same as for the sun.

Example III.—February 10, 1920, in approximately Lat. 5° S., Long. 100° E. had good horizon at about 6.45 p. m. ship's time (G. M. T. 0^h by chronometer).

	h m s	
Right ascension mean sun at G. M. noon	21 17 05.9	
Longitude	6 40 00.0	E. or +
	27 57 05.9	
	24	
Local sidereal time (L. S. T.) corresponding to noon, G. M. T.	3 57 05.9	

In nautical almanac under "Apparent Places of Stars," we find the two bright stars whose right ascension are nearest this time are α Persei and α Tauri (Aldebaran), the former having right ascension

	$3^h\ 18^m\ 38^s$,	Decl. 49° 34.8′ N.,
the latter	4 31 22,	16 20.9 N.

Corrected altitudes of each and time of sights were

(1) α Persei	34° 36.8′,	G. M. T. $0^h\ 2^m\ 54^s$
(2) α Tauri	67 18.4,	G. M. T. 0 4 00

For First Sight, α Persei.

	h	m	s
L. S. T. at noon G. M. T.	3	57	06
G. M. T. of observation	0	2	54
L. S. T. of observation	4	00	00
R. A. of α Persei	3	18	38
t of α Persei	0	41	22

Second Sight, α Tauri.

L. S. T. at noon G. M. T.	3	57	06
G. M. T. of observation	0	4	00
L. S. T. of observation	4	01	06
R. A. of α Tauri	4	31	22
t of α Tauri	0	30	16

First Sight. On lower scale: Lat. 5° S. and Decl. 49.6° N. gives

$$A = 38.4$$

Straight-edge through 38.4 and 41.4 gives $R = 45.0$.

Obs. alt.	34°	36.8′	
R		45.0	
Merid. alt.	35	21.8	
	90	00.0	
Z	54	38.2	S.
d	49	34.8	N.
L	5	03.4	S. (True L is 5° 04′ for data given)

Second Sight. On lower scale: Lat. 5° S. and Decl. 16.3° N. gives

$$A = 11.7.$$

Since t is over 30 and A less than 12 this sight cannot be worked by this method.

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REBUILDING THE NAVY'S ENLISTED PERSONNEL

By Lieutenant E. R. Henning, U. S. Navy

In a problem of this nature no time need be lost in the presentation of the lamentable details of the unsatisfactory condition of the naval personnel, both as to numbers and as to quality. Such details are common knowledge.

The situation is hazardous. It is costly.

For lack of trained men, dependence placed on recruits bears fruit in the tribute inexperience exacts—damage. And damage to ships, to machinery, is costly.

It will not be questioned that there must be a strong proportion of trained men in the battle fleet to maintain proper readiness for war. Nor will it be questioned that the proportion cannot drop below 50 per cent of the allowed enlisted complement without loss of efficiency. A gun deck, a fire and engine room, filled with recruits makes a battleship a training ship, with consequent low readiness for battle value. It may be regretted, but the days of the old frigates are past, the days when a captain could ship a green crew with a seasoning of old hands in June, and by October have a smart ship's company. To-day the activities aboard ship are more diverse than setting and furling sail, and running the smoothbores in and out.

It is not so much the question of enlisting men as re-enlisting them. Such resorts as the two-year enlistment defeat their own ends. The two-year man lacks interest—possibly because he knows his time in the navy is only brief. The expiration of his enlistment arrives at a bad time. At the end of four years most good men are rated or about to be. At the expiration of two years, however, it is the exceptional man, in peace times, who is a petty officer. The two-year man has been in long enough to feel all the disadvantages of the service, but not long enough to appreciate the

advantages. It is the low point of the morale curve. So out he goes when he is just arriving at a point where he is of value to the navy. The trouble and expense of his training are lost. The process begins over again with the recruit who takes his place. Initially, the two-year enlistments may gain more men, but in the long run the four-year enlistments should show a gain, not only in the quality and training of the men, but in their numbers.

The argument may be advanced that the short enlistment plan builds up a reserve. Granted, but of first importance is a sufficient active force. The navy cannot operate on its inactive reserve.

The problem is to keep men in the service, the skilled trained men. In private industry the employment problem has been met by an unprecedented increase in wages. Advance of service pay will not alone solve the personnel question for the navy. Service pay under the most favorable conditions will never approach that paid to men of corresponding ability in civilian life. Other inducements to remain in the service must be offered.

Why doesn't the bluejacket re-enlist? Evidently life holds more for him on the outside. His brother Bill writes him from Detroit where he is working in an automobile factory; writes about the car and his wife and the fur coat he bought her last week. Your machinist's mate or electrician ponders that letter and some invidious comparisons arise in his mind. Why shouldn't he get out and emulate or exceed Bill's success? They always considered him a more clever chap than Bill anyhow. What has he now? Three meals a day and a hammock. As for the girl back there in New Haven, he has a big chance, hasn't he?

So out goes your capable petty officer, and you struggle with a boy to take his place who has been in the navy four months.

There is another phase of the loss of trained men. The following is quoted from the Bureau of Navigation's letter of April 19, 1920:

> Requests for discharge for dependency are now being received at the average rate of 28 per day. An average of seven such requests are approved each day. With few exceptions, *the men making such requests are the older experienced men*. This produces a loss of about 200 trained men per month.

These men want to get out before their enlistments expire. A far greater number stick to the end of their enlistments, but for the same reason of dependency don't re-enlist.

It is a valid reason for men to wish to leave the service. Men of the petty officer class should be able to support a wife or dependent parent while in the navy as well as if they were working in a factory or office. Most men on reaching their twenties have dependents or responsibilities. Shall we exclude this class from the navy? Then, of course, we must be content with the boys we are enlisting at present, and content with losing them when they become men. Again quoting the Bureau of Navigation's letter:

. . . . It may therefore be stated that two-thirds of the present first enlistments are under 20 years of age. The remaining one-third do not average much above 20 years of age. . . . . Account must further be taken of the fact that the losses given in paragraph 7 (trained men) are steadily reducing the number of men *who can keep the wheels turning, and can assist in developing new men.*

There is an evil result following the refusal of these men to re-enlist. It is the demoralizing effect on the recruiting campaign. No amount of advertisement or other recruiting efforts are going to counteract the insidious effect of a mass of often disgruntled and dissatisfied men going out of the service. Conversely, the example of a large body of men contented and satisfied to remain in the navy would gain more recruits than the most elaborate recruiting campaign. A satisfied man is a splendid advertizer.

A story in a recent periodical illustrates the point.

A recruiting sergeant observed a young man outside the office gazing interestedly at the posters.

"Thinking of enlisting, my boy?" he inquired. "Fine life, good pay, education, travel, etc."

"I dunno," replied the youth. "I'll come back next week and see you."

"Better make up your mind now," urged the sergeant, "because I am getting out to-morrow."

What is the *bête-noire* of the seafaring life? Isn't it the little opportunity that exists for having a permanent home and enjoying the pleasures of one's fireside? These are elemental desires that at some time possess every man, be he a humble seaman or a choleric old bachelor officer. Herein can be found the solution of the personnel question; something to offer the trained men; a boon that will put a premium on efficient service.

To this end homeport the ships; make the homeport not a figure of speech as far as the personnel is concerned, but an

actuality. Make the homeports bases from which the ships operate; places from which the ships go out for their exercises and drills, and where they return; a week or two at sea followed by a week in port—the homeport.

There the men could establish their families. When off on cruises they could look forward with assurance to seeing their wives and families; to enjoying the relaxation of home after hard work at sea.

Yet another step is needed, a more radical step. It would improve the lot of the enlisted men little to simply homeport the ships. Even with the present increase in pay, the men in the service cannot meet the extortionate demands of the landlords, inevitable at any place where the navy may be in force. Many officers, nowadays, must smother their pride and live in quarters little above squalid. What chance is there, then, for the enlisted men?

That situation can be met too. At the homeports build modest quarters available for all petty officers who have wives or other dependents in their immediate families.

That, briefly, is the plan.

Keeping in spirit with the idea, there are some changes in the peace routine of the fleet necessary. The winter period at Guantanamo might with profit be reduced to a few weeks for the actual firing of target practice, if the admittedly ideal weather conditions are held indispensable. Many officers and men grow restive spending a fourth of each year off the sun-baked barrens of southern Cuba. Instead, a six weeks' cruise every year to Europe or South American waters would be found to have a tonic effect on the morale of all hands.

To the strenuous objectors to changing the long established routine of the fleet much might be said about certain disadvantages of a warm-weather fleet reorganized once or twice a year, and drilled up to a maximum of efficiency, followed by a period of relapse, and shifting or loss of a considerable part of the drilled crews. Certain factors of superiority might be pointed out in a fleet manned by a more permanent personnel whose efficiency was maintained at an even level—a fleet used to operating under the varying conditions met throughout the year in the North Atlantic. Permanent operating bases would overcome the idea that the Guantanamo period is the real worktime of the fleet, and that the

time in northern waters is a time of let up and turn over of personnel. The suggested plan would make an all the year around fleet.

For the Pacific fleet, the adoption of the plan would compel less change in the operating routine than for the Atlantic fleet.

The cost would not be prohibitive. Millions have been spent by industrial concerns in executing housing and other schemes for the contentment of their employees. When consideration is given to the saving in upkeep and economic operation with skilled trained crews, and the cutting down of machinery accidents so frequent with recruits, no stretch of the imagination is required to see an actual gain in the dollars and cents operating cost of the navy.

What places are most available for these bases for the personnel? On the east coast there are such places as Newport, Yorktown, and Hampton Roads; on the west coast San Francisco, San Pedro, and San Diego.

No doubt this plan will inspire some very valid objections, but it will get and hold good men—the paramount consideration in the navy at present.

On the other hand, there will be those who will throw up their hands in horror and ask what the navy is coming to; those to whom it is inherent to object to any change in traditional policy; the class who will never remember that the days of the men who manned the old square riggers have passed—the days when men would ship for 15- or 20-month cruises, men to whom it was all in a day's work to tear the nails off their hands furling ice-coated sails in a North Atlantic gale, cursed at from below by a bucko mate with a ready fist or belaying pin. Watch on deck and watch below, and a staple diet perhaps of salt horse and biscuits; this it was for a few dollars a month and a drunken carousal ashore after a cruise.

Of course, the day of that kind of American has long since passed. The man who follows the sea expects as much out of life as the worker ashore.

There will always be a considerable minority who will want cruising duty, particularly the young recruit. For them, duty should be open on the cruising ships, the ships on foreign stations.

I may digress here to say there are certain advantages in sending recruits to the smaller ships on detached duty. Most officers

will concur that there is more opportunity for the newly enlisted man to learn the elementary things on a gunboat or small cruiser than there is on a battleship. In the small ship's company, each man is more nearly under the direct supervision of his officers; more time can be devoted to his individual instruction; his duties are more diverse. He becomes an all around sailorman. On the other hand, the recruit on the battleship is an unnoticed unit in a thousand men. The handling-room crew, a life-buoy watch at sea, and a certain allotted space of paint work to scrub—that may be his duty for months.

The best sailormen I have ever seen were on a navy oil tanker. Nearly all recruits, when the ship went in commission, in a few months all but a few could steer, heave the lead, keep a sharp intelligent lookout, and knew how to handle a rifle. They could get away a lifeboat smartly, and put their backs to the oars, without that ludicrous exhibition that a boat's crew from a battleship so often present. The snap and expertness they attained in handling the 4-inch guns I have seldom found equaled by the broadside crews of a battleship.

There follows another advantage of the suggested plan. About the time the new man tires of strange scenes and movement, and wants to stay in one place for a while, he knows he has the chance sooner or later of going to one of the ships with a homeport. The prize of quarters puts a premium on obtaining a rating. It creates an incentive for hard work and good conduct.

Thus, the fleets with their homeports should have the highest percentage of trained men. Valuable time for advanced work need not be taken up in elementary drills for recruits.

The bluejacket could see a future before him, the chance for a home and a family the same as the fellow on the outside. Many men that we are now losing would re-enlist with the adoption of this plan; many who are now out would rejoin the service. The personnel would be stabilized. The married man is less prone to change than the bachelor. Contentment, and *esprit de corps*, lacking in the navy now, could well be expected with this plan.

Upon the submarine to which I am attached, the quartermaster is leaving the navy in August because he has a wife in the States whom he has not seen for months, and whom he can't afford to bring down to the Canal Zone and support there, at the high cost of quarters in Colon. He extended his enlistment a year

when he was enabled to transfer to a submarine basing on the Canal Zone because he heard that "there were quarters for married men there." Disillusioned, of course, he is getting out.

Again, there is an electrician first-class—the only enlisted man aboard the boat, other than the chief electrician, who can be depended upon for electrical work; discounting two short enlistment recruits "striking" for electrician who show little energy or interest in qualifying for a rating. This capable electrician, however, leaves the service in a month. He is going to get married. Splendid material, with two years of engineering at Lehigh behind him, likes the navy immensely, he would re-enlist were there quarters for married petty officers on the submarine base. The recruits will have to do his work.

I make bold to say that the navy has never gone at its personnel problem with the soundness of policy of big business. Probably, because with the latter it is solely a matter of dollars and cents, unhampered by any traditional point of view. Efficient industry has scrutinized all its activities; the success of a process is its justification. What does not pay is cut out with a ruthless hand.

The point of view in the navy must undergo that orientation so that the handling of the personnel is such as will get and hold the men who will fight the ships the best—whether the method counters tradition or not.

Disregarding a century of traditional tactics, Nelson broke through the Line Ahead formation at Trafalgar. If we break through the "line ahead" in the traditional handling of personnel, we may attain as startling a success.

Finally, if this plan will not keep the ship's companies filled with the right kind of men and enough of them, outside of an increase in pay far in excess of that recently granted—what can be offered the enlisted personnel?

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

FUNCTIONS OF THE OFFICE OF NAVAL OPERATIONS

By COMMANDER R. CASTEX, French Navy

Translated by PROF. ALLAN WESTCOTT, U. S. Naval Academy

I have recently read with keen interest the excellent article by Commander A. F. Carter, in the U. S. NAVAL INSTITUTE PROCEEDINGS for February, 1920, on *The Functions of the Office of Naval Operations*. This question presents itself in every country, and as it is of capital importance, I should like to set forth certain general considerations on the subject, which it may be useful to correlate with those expressed by Commander Carter.

For greater simplicity, I shall refer in these considerations to the institution that controls naval operations in France, that is, the general staff—*état-major général* (E. M. G.).

The evolution of ideas regarding the general staff, which has manifested itself recently in the French Navy after the remarkable example set by the army, has led to the recognition of two fundamental principles for the organization of the general staff:

1. Absolute separation between the *general staff*, entrusted with the objective preparation for war, and the various administrative bureaus, entrusted with the subjective realization of the plans of the general staff, and each concerned with a single phase of naval activity or a single corps (personnel, yards and docks, health, naval construction, ordnance, etc.).

2. The internal organization of the general staff in three bureaus, as in the army, these bureaus permitting the general staff to accomplish the three parts of its objective task, which is, in the current phrase, *savoir, vouloir, pouvoir,* which may be freely translated, to understand, to decide, and to provide means for the execution. The three bureaus are as follows:

First bureau—Organization (pouvoir).
Second bureau—Information (savoir).
Third bureau—Operations (vouloir).

The office of naval operations, as understood by Commander Carter, is thus, in France, the third bureau of the general staff. It is to this bureau that the following study refers, but it may also be applied to any organization for a similar purpose.

I may add at this point that what I am about to say of the functions of the third bureau represents purely personal conceptions, and need not be considered in any sense as official doctrine.

The theoretical functions of the third bureau of the general staff may be grouped as follows, combining those of peace-time and those of war-time:

A. *Operations.*—Preparation and execution of operations. Plans of operations. Orders and instructions for operations.

Operations of surface forces, patrol forces, aerial forces, submarine forces, merchant marine. Protection of commerce and fishing craft.

Operations of coast attack and coast defense. Liaison with land forces.

Landing operations.

Record of naval operations. Record of losses.

B. *Movements.*—Fleet movements. Distribution of forces. Current ship movements.

C. *Instruction and Training.*—Preparation of personnel for war. Exercises. Maneuvers. Courses for training schools.

Strategical and tactical studies. Practical problems. Military ideas. Doctrine.

D. *Liaisons.*—Missions abroad. Sending and receiving of liaison officers.

Personnel of Bureau.—For a large navy, it would seem that these functions, in time of peace, could be carried out by a force of eight officers, in addition to the bureau chief,—*i. e.,* four for operations, two for movements, and two for training. The liaison service would be constituted only in time of war, and on this account the force required would differ in war and in peace. In war time four officers at least should be provided for liaison.

The chief of general staff would presumably keep in constant touch with the third bureau, in view of the importance of its work. One of the two sub-chiefs would be permanently at the head of this bureau and the second.

Plans of Operation.—The preparation of plans of operations is the essential and fundamental rôle of the third bureau. It would prepare them both in time of war and in time of peace. The only difference between the two situations would be that, in the second case, it would have more time and more freedom of mind than in the first. The *plan of operations* is a document of capital importance. It expresses the general purpose, the very end and reason for being of the navy. It is the basis of everything. It is the skeleton of the organization. Into it should articulate and from it should branch out all personnel, material, industrial, and financial provisions. Even if it is not always easy to realize them—since they may call for means that are lacking—the plan of operations should at least clearly set forth the objectives to be attained.

The plan of operations is above all objective. It proposes to operate against someone, against something, in a word, against an enemy. It is thus completely guided by the political conditions of the moment. As has sometime been said, "One does not prepare for *war,* one prepares for *a war.*"

We need not concern ourselves here with the fundamental qualities which a plan of operations should possess; that is, with the strategical properties which it should combine. We have in view only its form.

On this latter point, Von der Goltz has written, in *A Nation Armed,* a passage which gives an idea of the subject and may serve as a guide. He says:

> The plan of operations should be presented in the form of a memoir which begins with considerations on the political and military situation, and a comparison of the forces opposed, and decides therefrom the general line of conduct and the choice between the offensive and the defensive.
>
> The memoir should next set forth what the adversary can do and where he will effect the strategical deployment of his forces. It will explain where we shall deploy ours and how they shall be grouped. It will determine the choice of directions for our first movements, the aim of which is to bring about a decisive battle. . . . .
>
> Here the offensive plan and the defensive plan separate. The first goes on, indicating the general purpose to pursue until the adversary is forced to conclude peace. The defensive plan stops at the turning point which permits assumption of the offensive.

These words in effect summarize what a plan of operations should contain, and constitute a useful outline, provided it is given

a little order and the subjects touched on are classified according to their nature.

In my opinion, the plan of operations, being objective, belongs to the category of orders or instructions which have to be prepared with a view to operations. There is indeed only advantage to be gained by putting it in the well-known form and subdividing it into three main divisions in the order "situation, mission, execution." Such a division of material will add clearness and will oblige those preparing it to follow a logical sequence, consisting, as customary in orders for operations, of first stating the problem and then supplying the solution.

The part relating to "situation" has here a particular importance and character, in view of the size of the question treated and the intervention of factors connected.

"The plan of operations is only one part of the plan of war," and this is seen when its preparation is undertaken. It is then evident that the plan must take account of an infinity of considerations not apparent on first examination. It must take account, first, of plans for land operations, and if these seem of primary importance for success in the war, the plan of naval operations must be modified to supply the aid which it ought to render. Everything relating to external politics should be carefully envisaged, with the same object in view. The same also with economic elements in the conflict, and if possible with the financial conditions. No less care should be taken to grasp the elements which sustain the morale of the warring nations. The plan of naval operations is thus in close relation with other plans, its fellows, which constitute with it the plan of war,—the army plan, diplomatic plan, economic plan, financial plan, morale plan, etc.

It follows therefore that the part relating to "situation" in the naval plan should have corresponding subdivisions, *i. e.*,

1. Enemy naval situation.
2. Naval personnel situation.
3. Military situation on land.
4. Diplomatic situation.
5. Economic situation.
6. Financial situation.
7. Morale situation.

And every other "situation" which it appears necessary to envisage.[1]

The enemy naval situation calls for close examination of the adversary's material, resources, ships available of all types, aircraft, etc. . . . . ; his faculties of mobilization (numbers, period required for the operation, etc.) ; his possible time and points of concentration; the operations he may plan; the support he will be able to draw from his bases; his coast defenses; the training and worth of his personnel; his strategical and tactical policies; the character and military ideas of his leaders, etc. This makes an important document, in which are gathered up the patient labors of the second bureau in time of peace.

The same labors will be utilized for our own forces, to supply a concise account of the means at our disposal, the places and stages of their concentration, and the sources of supplies that may be utilized. Our secondary characteristics (training, morale, etc.) should likewise be studied. All this gives us the "naval personnel situation," the greater part of which is based on information supplied by the first bureau. This part will not treat of operations, which belong to the "Mission."[2]

The military situation on land will be given very serious consideration. In its main outlines at least, the plan of operations of the armies should be understood, in order to provide for support by the navy, or inversely, according to the objective which it appears most urgent to attain. If a combined operation is contemplated, the study will not be limited to this general survey, but will naturally go into details. This implies, in time of peace, an intimate contact between the third bureaus of the army and navy general staffs.

The diplomatic situation will be summarized similarly in cooperation with the Minister of Foreign Affairs.

The economic situation, situation relating to morale, etc., will be examined in the same way.

Finally it is essential not to lose sight of the geographical situation. It will supply material for study regarding the presumable

[1] For an example of such a study see Lt. Col. Nordacq, Étude d'une situation strategique, *Revue militaire generale,* March, 1913.

[2] The naval personnel situation should include that of allies, if such there be.

theatre of future operations, and will call for all information available concerning routes, distances, strategic points, anchorages, hydrography, climate, marine and aerial conditions, facilities for blockade, etc.[3]

Map sketches will aid in this study. The aim should be to establish not only this "geographical situation," but also the desiderata relative to organization of the theatre of operations (permanent or temporary bases, supplies, communications, etc.) which belong in the part "execution."

To summarize, the part dealing with "situation" should, it appears to me, be composed of a certain number of separate statements dealing with divers particular situations, acompanied by a résumé of the whole defining the general situation.

The division "mission" will study the different possible solutions of the military problem, based on what is known of the situation, the enemy's possible efforts, and what we are able to do ourselves. It will determine the operations possible and desirable, both principal and secondary (transport, commerce warfare, coast attack, blockade, etc.). It will evidently be necessary in this research to examine a considerable number of hypotheses, and to survey various means of attaining the same result. Such thoroughgoing discussion is possible here, for the plan of operations is neither orders nor even instructions, but simply a forecast, a preliminary investigation, which is not intended for subordinates, and which serves only to clarify the ideas of the composers. This will permit the elaborateness of a comparative study. Nevertheless, the conclusions should be as decisive and definite, in regard to operations to be undertaken, as if it were an order.[4]

The division "execution" will lay down the measures necessary for the realization of the operations contemplated. It will determine the forces to assemble, the place and time of their assembly; it will calculate the forces to be provided beforehand in time of peace, and the required measures of mobilization, both for the active service and the reserve. This work will cover all types

[3] Types of studies of geographical situation: (1) Mahan, *The Problem of Asia*, study of the North Pacific (p. 31), study of the Caribbean (ch. VIII). (2) *Revue Maritime*, 1911, Vol. 188, study of the North Sea Theater of Operations (German article).

[4] This discussion of *mission* implies liaison and understanding with land forces and with allies.

of forces—surface, submarine, aerial, patrol (requisitioned ships), merchant marine, coast defense, etc., commencing with the most important and continuing down. It will end with logistical prescriptions, regarding permanent and temporary bases, train, convoys, etc. All this division "execution," when finished, will be communicated to the first bureau, which will fix definitely, entering into greater detail, the organization, constitution, and distribution of forces and material. The first bureau will communicate this information in turn to the various branches of the service, which will base their own plans thereon. Such is the theoretical method of establishing a plan of operations, with its appendices.[5]

All the work thus far outlined is within the general staff office. To bring the plan to the attention of those concerned, secret instructions will be sent out, based on the plan and designed to provide for its execution. Certain of these instructions will deal with measures to be taken in time of peace; others with measures in time of diplomatic tension and mobilization; still others with operations properly so called.

The plan of operations thus established is not fixed beyond all change. It develops constantly, even in time of peace, according to developments in the *situation,* and especially in the political situation. It will therefore be more or less frequently revised and brought up to date.

Besides, this plan is not supposed to foresee the entire unfolding of a war. It is limited to the initial phase, and the best presentation of forces. In the course of hostilities, as the situation changes, it will be necessary to study anew, produce other plans, and issue other instructions.[6] That is what the phrase "conducting war" means.

Journal of Operations.—It is desirable that the third bureau in time of war should keep the log or journal of naval operations. All facts of interest will be there recorded, and mention made of

[5] This sketch of a *plan of operations* will also serve as a preliminary study for *orders* for particularly important operations, from whatever general staff they may emanate.

[6] With this in view, the third bureau will in time of war maintain the same relations as in time of peace with the first and second bureaus, the direction of land operations, the government, the foreign office, other ministers concerned, and the forces of allies.

orders and instructions for operations, to be found in full elsewhere.

Losses in personnel and matériel, and in particular losses of naval and merchant vessels, will be appended to the journal.

Movements.—The movements of the fleet have always properly been regarded as essentially under the cognizance of the general staff. Every movement in fact involves the idea of management, of utilization of forces, which is the business only of the general staff.

Within the general staff office, movements should be allotted to the third bureau. They are in fact closely linked with operations, since every change in the geographical distribution of units affects previously made plans, and inversely, these plans may require certain changes in the movements, as measures of either execution or preparation. It is therefore logical that the third bureau of the general staff, having charge of the plans of operations, should know how its units are distributed and consequently have cognizance of movements.

It is desirable, moreover, to take the word "movements" in its broadest sense. It should apply to all operations of putting ships into or out of commission, or into reserve, condemnation, division and grouping of naval forces both active and reserve, classification of ships as to readiness for service, etc. In this respect also, the third bureau should thus be in close contact with the first bureau. The latter will give to the third bureau all the required information regarding the forces and resources available.

Instruction and Training.—The proper instruction of personnel for war is achieved only by a series of incessant efforts and intensive training in time of peace, beginning with elementary exercises and terminating with fleet maneuvers. It is evident that the general staff should supervise and prescribe the ordinary execution of these exercises, for it alone knows to what ends the efforts of all should be directed. It is as responsible in this respect as in matters of matériel.

This function goes logically to the third bureau, belonging properly, like movements, to those external activities coming under the head of operations. This bureau will therefore concern itself with the training of the various arms of the service,—gunnery, torpedo, submarine, aeronautics, etc.,—and with the exercises by which it is accomplished. It will extend its cognizance to grand

maneuvers intended to bring these arms into harmonious cooperation, and to throw light on important questions of strategy and tactics. To this end it will give the necessary directions, and examine and criticize the results.

But while playing this rôle of guide and supervisor of training, as regards general doctrine and aims, it can work only to the advantage of the third bureau of the general staff to delegate to the various branches of the service the details of such training, when circumstances permit. It is fitting enough, for example, that the office in control of ordnance, including as it does naval officers, should establish regulations for target practice, or that the office in control of submarines should issue instructions for torpedoes or submarine training, after having consulted the third bureau as regards the main outlines of these documents. The same is true of aeronautics. This would permit the general staff, while accomplishing what is expected of it, to avoid becoming overloaded with details. It would limit itself to giving general suggestions to the service, and supervising the plans of the latter before they take definitive form.

The preparation of personnel, before it is carried out in active service, begins however in the various special schools. The third bureau will have therefore, not the actual direction of these schools, but supervision over the instruction given. If only for the sake of knowing what it may expect of each branch of the service, it will consequently set the requirements for admission and the course of instruction in all institutions engaged in training for the navy, whether for line or staff, for officers or enlisted men, or for whatever specialty.

Doctrine. Studies and Military Principles. Directional and Educational Rôle of General Staff.—In a higher degree, for officers, preparation should mean not only professional and technical knowledge of matériel, but a grounding in important military principles and matters of war.

It is superfluous to call attention here to the necessity of community of thought among the members of a military force destined to fight together. This alone will assure, in time of peace and during hostilities, convergence of effort and continuity of policy in command. This is what is called " unity of doctrine," even though this phrase has sometimes been distorted and taken to mean the establishment of such a synchronism that every officer will auto-

matically see a given situation from the same angle. Such enslavement to doctrine is unnecessary, for it would mean killing initiative. "In spite of unity of doctrine, a given situation will as a rule suggest more or less divergent solutions as a result of individual temperament and type of mind. Unity of doctrine is powerless, indeed, to bring about that a situation, an event, shall produce the identical reaction in all. But it prevents anarchy of ideas, and for this reason it is of inestimable value."[7] The essential thing therefore, in matters of higher military training, is to avoid fundamental divergences in individual conceptions.

This doctrine, since a doctrine it is, is especially necessary in the navy, for this environment, more than any other, seems completely ruled by perfectioning of matériel, by scientific discoveries, and by the appearance from time to time of new instruments which give rise often to misguided ideas. In the employment of these instruments there is a danger to be guarded against of frequent disturbance of mind and of crises during which the general state of mind and military ideas oscillate seriously.[8] This should be remedied by doctrine. Its beneficent effect, moreover, is not limited to military action in the narrower sense; it extends also to matériel and its characteristics. Often after long periods of peace, with no proof from practical experience, there are genuine difficulties in this respect. Improvements in the mechanical sphere seem completely revolutionary; sensational achievements of foreign navies create an unreflecting desire to copy them slavishly; public opinion is concentrated on machines the practical value of which is unknown. It is then, in this general confusion, that a firm doctrine may render real service. It is moreover implicitly necessitated by the fact that it is the combatant personnel who must primarily decide what qualities are to be called for in matters of matériel.

In all these moments of perplexity, we await a voice from above to set the course anew, define the policy to be pursued, and orient the service in the new conception. We feel that we cannot without peril allow anarchy, as so often in the past, to dominate our military ideas.

Now this guidance can come only from the institution responsible for the war training of personnel, that is, from the general

[7] General Bonnal.

[8] Example: The uneasiness of mind after the World War, brought about by the outstanding facts of submarine and aircraft development.

staff. This function, in its full sense, includes also the task of filling the minds of the service with the same ideal, of spreading abroad the same ideas on the conduct of war, the training of men, and the mastery of matériel. It is essential that the general staff should take account from time to time of the intellectual needs of the officers, of their uncertainties also, to let them know that a superior control has considered the problem which occupies them and its solution. This is one of the highest rôles of the general staff, and a rôle which it alone is able to fill.

Marshal Foch once summarized the double function in this respect of the army chief of general staff:

> Not only to take care of the army in a material way, assuring its concentration for mobilization, but also to prepare and instruct it for the requirements of modern war, and to develop in particular, in a general staff corps trained by him in his doctrine, the unity of opinion alone capable of assuring convergence of all efforts in execution.

This intellectual guidance in the preparation of personnel enters into the attributions of the third bureau. The chief of general staff will naturally take up the matter most closely. In accordance with his suggestions, the third bureau will undertake the action necessary to attain a rational military doctrine, based both on past experience and upon what logical deduction is able to forecast for the future; above all it must be adapted constantly to the continuous changes in weapons and machines.

The third bureau will keep informed of what is said or written, at home and abroad, in military matters, in order to discuss and assimilate or reject it as the case may be. If the need arises, it will take the initiative in studies of this character, carrying them out itself or confiding them to other officers, who will work in accordance with its directions. It will draw up a report and a *critique* of naval maneuvers, and it will extract from these exercises whatever it considers useful for the intellectual guidance of the whole combatant corps. Likewise, every war will call for a work of the same kind, so far as information available permits, accompanied by deductions and comments. Moreover, aside from such circumstances, if cases arise where, in the presence of general uncertainty or numerous individual divergencies, it is necessary to take the lead and rally all minds to one opinion which it considers sound, the third bureau will accomplish this by expressing its views by means of circular notes summarizing a point of doctrine,

and going out officially to all officers. Other occasions for similar action will often occur in connection with the dissemination of despatches or official circulars dealing with service matters; they will afford means of incidentally calling to mind essential military principles and thus diffusing the views of the body in control. These will supplement the other procedures.

It will do no harm, moreover, if the third bureau extends its educational rôle beyond the navy, and exercises it especially upon public and parliamentary opinion, to win them over to its ideas and thus facilitate their realization, which, in every country with a democratic government, depends upon these two factors. This also is quite in the spirit of preparation for war. The general staff should concern itself with the state of opinion in regard to naval problems, and lead the struggle for the view it believes right. Advantage will be gained by suggesting or even preparing press articles defending its theories and forcing their consideration and also by authorizing some of its members to give lectures expounding [*] official views, thus getting in touch with the associations which lead public opinion in naval matters.

A similar policy should be pursued by the third bureau in respect to members of parliament. It should supply them frequently with information and also, after the excellent custom of the British admiralty, address them periodically in memoirs which explain its views and its considered policies. It should as often as possible invite the naval committees of the two houses to visit naval bases and even attend naval maneuvers.

Similarly the general staff, by the intermediary of the third bureau, should exercise control over the institution for instruction in strategy and tactics, that is, the naval war college, which will at the same time constitute a supplementary source of information for the staff. This leads me to insist on the necessity of close unity of thought between the general staff and the war college. These two institutions should intimately collaborate. Both will derive sure benefit. The general staff will thus be able to impress its ideas upon the officers who will later occupy all the posts of the general staff. Inversely, the general staff will have available in the war college a kind of studies section.

[*] The general staff of the German army established in 1903 a quarterly review intended to voice its opinions.

unpreoccupied by routine duties, where one may meditate at leisure on the problems of the hour. These may be set for solution there, and much of the work of the college, especially its map work, will contribute usefully to the clearing up of doubtful points on which the general staff will be glad to have advice. This link between general staff and war college, where such exists, is moreover the rule in many navies.[10] Aside from the personal action of the chief of general staff, and the control exercised by him over the entrance examinations and courses of instruction, this union may be assured by assigning several important courses to officers of the general staff.

Strategic Liaisons.—This part of its duties will in time of war form a large part of the activities of the third bureau of the general staff. It will thus centralize the service of outside missions. It will send out liaison officers to subordinate units, to fleets, naval districts, bases, etc. . . . . It will cooperate also, the case occurring, with the allied naval forces and higher commands, or even with land forces, if the situation requires. Reciprocally, the third bureau will have the duty of receiving the liaison officers sent from these sources. It will put them in touch with the subchief and the chief of the general staff. Then, their report made, these officers will be re-attached to the third bureau and work with it during their sojourn with the general staff, before leaving to rejoin their units.

They will thus have lived for some time in the environment of the central control, breathing its atmosphere, absorbing its ideas, and thus accomplishing what is expected of liaison officers.

[10] Before the war of 1914, the Naval War College at Portsmouth worked in liaison with what was then the British General Staff (Intelligence Department). In the United States, the Naval War College at Newport was considered as an adjunct of the Office of Naval Intelligence (American General Staff). In Germany, officers leaving the college nearly always were detailed to the *Admiralstab.*

DISCUSSION

What is the Matter with Operating Engineering?

(SEE PAGE 1431, WHOLE NO. 211)

LIEUT. COMMANDER R. R. SMITH, U. S. Navy.—The article in the September number by Lieut. Commander H. F. D. Davis, U. S. Navy, inquiring as to "What is the Matter with Operating Engineering?" covers a subject which is becoming of increasing importance. This is particularly so in view of the tremendous increase in the number of new vessels, the engineering plants of which vary widely in type and design from each other, chiefly as a result of the development of turbine engineering. As long as the reciprocating engine was the standard type of marine propulsion and the chief difference between ships was that of size, operating practices were well standardized and repairs and casualties were covered by well established practices. With the advent of turbines, and the steady improvements in their design and combinations both by the manufacturers and the Bureau of Engineering, a similar change was introduced in engine room auxiliaries involving radical departures from previous types.

The engineer who keeps abreast of these changes finds that the knowledge acquired yesterday no longer holds to-day; that the turbine even before its complete development is being supplemented in capital ships by electric drive. It is not surprising, then, that the older engineer finds much of his knowledge insufficient and that the new engineer operates the plant at his disposal more with a view to safety than economy. The situation is further aggravated by the outpouring of new ships, built at great cost, for which supervising and engineering personnel is not available.

It is hard to concur in the statement in the commanding officer's letter, that "there has never been more competent commissioned engineering talent in the battleship force than is the case to-day." However, it may be so for the force in question but the same cannot be said for the service at large.

A comparison has been made between gunnery and engineering performance. Gunnery has been developed from the stimulus it has received from the seagoing personnel, whereas the development of engineering has taken place chiefly from shore. The gunnery officer serves a longer apprenticeship at his work and is, therefore, more conversant with the details of the ordnance equipment of his ship. His time is not wholly occupied with the upkeep of the matériel and he has a greater opportunity to devote his time to the development and training of the personnel and to work out and develop new ideas in connection with personnel, matériel and methods.

The average engineer officer enjoys the title of his office because he has been so detailed and not because he has been trained as such. His responsibilities are such as to keep him fully occupied in the upkeep and successful operation of the plant while the personnel duties which are performed by the executive officer for the deck force are discharged by the engineer officer for his force. Without special training he is dependent upon his subordinates for the really important mechanical decisions, and never reaches the point where his work becomes constructive rather than routine. He leaves the development and improvement of engineering matériel to the Bureau of Engineering. I am speaking of the average engineer officer; there are, of course, many exceptions.

Does the engineer officer of a ship regard his work as a preparatory step to higher command as does the navigator, the executive or the gunnery officer? He does not, and he also realizes that he must not be too closely identified with engineering duty for too great a length of time lest it work to his detriment. When an officer is assigned to engineering duty only he is in the happy position of being able to devote himself unreservedly to engineering. The officer who prefers engineering work but whose application for engineering only is declined must turn to something else under present conditions.

The answer to the question "What is the Matter with Operating Engineering?" is, "There are not enough operating engineers of proper experience to handle the engineering plants of the ships of the navy." If we are to interest officers to become skilled engineers we must hold out some inducements to them—a condition which does not exist at present. What is sadly needed is a policy on this subject. Until a definite policy is established with relation to the operating engineering personnel which will foster interest in engineering and place it on the same honored plane as gunnery, we will have to be content with present conditions.

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ANNAPOLIS, MD., November 15, 1920.

INFORMATION INDEX

PROFESSIONAL NOTES

PREPARED BY

LIEUT. COMMANDER H. W. UNDERWOOD, U. S. Navy

GENERAL ARRANGEMENT

FRANCE

COAST DEFENCE.—The news transmitted by our Paris correspondent that the guns of condemned French battleships are to be used for augmenting the defences of the principal ports will have surprised many readers, who were probably under the impression that the chief harbors of the Republic were already equipped with powerful defensive works. Brest, Cherbourg, and Toulon have always been regarded here as fortresses of the first rank, but our correspondent shows this impression to be wrong. Their heaviest armament appears to consist of "a few short-range 240 mm. (9.4-in.) guns," which certainly could not have beaten off an attack from the sea by modern capital ships. The Germans no doubt were fully apprised of the comparatively defenceless state of the French coastline, for it is now known that in the closing days of July, 1914, they were preparing a series of naval attacks on the Channel ports of our ally. The responsibility for coast defence, which was formerly in the hands of the army, has now been transferred to the navy, but it does not appear that money is to be spent on elaborate fortifications. The French view is that the fixed defences of a harbor may safely be limited to a few heavy quick-firers sufficient to repel cruiser raids, leaving submarines to protect the coast from bombardment by dreadnoughts. We notice, however, that stronger works, armed with supercaliber guns, are recommended for particularly exposed ports, such as Dunkirk, Cherbourg, and Bizerta. It cannot be said that the war has taught us anything new in regard to coast defence. The Germans converted the Flemish seaboard between Westend and Knocke into a seemingly impregnable rampart, but the Zeebrugge exploit showed that no fixed defences are capable of resisting a surprise attack if it be skilfully conceived and carried out by determined men. Heligoland was another disappointment to the enemy, for its monster guns and powerful rock batteries failed to prevent our forces from penetrating on occasion well into the sacred Bight. The aversion to brick-and-mortar defences was doubtless carried too far in the case of our Northern bases, which had to

be hastily armed with improvised batteries in the early days of the war. But it is certain that no case has been made out for spending large sums of money on improving the fixed coast defences of the United Kingdom.—*The Naval and Military Record,* Oct. 20, 1920.

FRENCH VIEW OF SUPER-CANON.—The question of super-canon is the object of much controversy. The Boche "Berthas" that bombarded Paris at 120 kilométre ranges at the rate of one round every 12 minutes might intimidate civilians, but they would have no value whatever for bombarding a fleet on the high sea or for defending a narrow sea passage such as the Channel or the Mediterranean Straits. Quick, accurate fire can alone be effective against warships; and it is a fact that Parisians, who rather disliked night bombardment by airplanes, mostly laughed at the performances of the Berthas. So the most efficient batteries for such exposed positions as Dunkirk, Cherbourg, St. Nazaire, and Bizerta must be made up of the heaviest types of naval ordnance, 16- or 17-inch guns of the latest design, firing at the rate of one or two rounds per minute. But not a few experts, some of them holding posts of influence at Rue Royale, consider the gun as being altogether out of date for coastal operations. Aerial scouting and bombarding flotillas, acting in co-operation with submersibles, are, in their opinion, all that is necessary to control the sea passages round the French coasts. To this contention old officers reply that the gun is reliable in all weathers, whereas the submarine and aerial machines, besides costing much more in construction and upkeep, might turn out to be useless when wanted.—*The Naval and Military Record,* Oct. 13, 1920

NEW FRENCH NAVAL ERA.—The naval outlook is, in a sense, brighter than at any previous period under the Troisieme République. On paper at least two conditions of maritime greatness are being realized that had ceased to exist for the last 50 years, viz., stability in direction and the presence at the head of the state of "Big Navy" men. It looks this time as if the former policy of spasmodic and vain efforts and of everchanging paper programmes were to make room for a new era of steady and uninterrupted developments along progressive lines. The Marine Française that succeeded in preserving a substantial degree of efficiency when managed in defiance of the laws of common sense and changing heads every few months is, of course, bound to thrive once stability and competence have been restored in its direction. Ministries of 27 years' continuous duration, like that of the great Colbert, or of 17 years, like that of Tirpitz in Germany, are not possible under the Republican régime, and Frenchmen would be satisfied with conditions of stability similar to those that obtain in Great Britain and in the United States, especially if the Chef d'Etat-Major Général can be maintained in his responsible post for a period of four or five years, so as to ensure real authority and continuous progress; and so much is likely to be obtained to judge from the facts stated hereafter.

President Millerand's first official act as President speaks for itself; he maintained in power, contrary to previous practices, and to the intense disgust of professional politicians, the whole Ministerial team he had selected himself in January last. Not only does Minister Sandry remain at Rue Royale, but the new Prime Minister is Mons. Leygues, who was Marine Minister under the Clemenceau Ministry, and is a well-known partisan of a strong navy. The latter may even be claimed to have been our best Ministre de la Marine, so far as eloquence, good intentions, and genuine optimism are concerned. No one has spoken more beautifully of the rôle the French Navy has played in the war. Mathurin and those who command Mathurin have in him a tried friend and an able defender. More than once he has ungrudgingly rendered public justice to the premier services of Jack Tar, and the alliance with Great Britain has in him a convinced and devoted champion. His motto is that of Richelieu, the

founder of the navy: "Sans la marine on ne peut ni soutenir la guerre ni profiter de la paix." He means France to "reprendre sur des bases élargies la vaste politique économique et maritime qu'elle suivit aux grandes époques de son histoire" (Ministerial declaration, October, 1918)—to resume on a wider basis the comprehensive, economical, and maritime policy France adopted at the most glorious times in her history. In truth it must be said he has done nothing to that end beyond discarding the half-completed 25,000-ton Normandies, and the Commission de la Marine bitterly reproached him with failing to utilize the credits Parliament had voted for new construction. But then he had not the power and chances of longevity he now enjoys, and in naval circles much is expected of the new Premier's patriotism and good will, all the more so as he will have an all-powerful supporter in President Millerand, who is a believer in sea power, and has proved, when acting as chairman of the Ligue Maritime, the most go-ahead propagandist that influential association has yet known. Mons. Millerand is thus a naval President, and, up to date, he is the first to have any claim to that title. At no previous time were there in power so many friends of the navy. No wonder, therefore, that a change for the better is looked for in the present rather gloomy naval outlook.

The continuance of the present ministry is a matter for satisfaction. The earnestness, work power, and managing ability of Mons. Landry are unanimously acknowledged. The inadequate 1918 Leygues programme he has considerably enlarged and improved, at least on paper. The 1921 budget, to be discussed next month by Parliament, will mark a first step towards expansion on new lines. Mons. Landry is a silent worker who wastes very little time in empty or showy manifestations; and not only does he work hard himself—and this is the first condition of Ministerial efficiency—but he has the secret of making others work silently, methodically, and effectively. Far more is being prepared and done at Rue Royale than appears on the surface, and there is no justification for the grumbling and sarcasms to which the outward inertia of the Paris Admiralty is giving rise in some quarters. The delay in ordering the projected cruisers and destroyers will turn out in the end to be a good thing for the navy. Had not the constructional programme been thoroughly revised in the light of war experience and of the progress realized by rival navies, inferior units would already be in hand that would not have been worth their heavy cost. Superiority alone pays. It is obvious that cruisers of 30-knot speed, and carrying 5.5-inch weapons, would not only be outclassed by the latest British and American scouts, the mount 7.5- and 8-inch guns, but would, besides, fail to outmatch the cruisers of Mediterranean Powers, which is one of their raisons d'être. France would have been repeating the disastrous blunder the Boches committed with their pre-war Kleine Kreuzer. No amount of eloquence can make up for inferiority in the matter of speed and caliber, and those experts who are arguing about the superlative and exclusive qualities of the 140 mm. are indulging in a gratuitous and childish form of error. Moreover, the enlarged croiseurs légers will be ready as soon as they would have been if ordered six months since, as the result of improved constructional methods.

The "cuirassséphobie" or wave of antagonism to the battleship that swept through the service in 1918-19 (Admirals Daveluy, Buchard, Degouy, and so many others joining in the fray against the mastodon) is visibly abating Mons. Landry, who at first entered Rue Royale with the avowed intention to "supprimer les cuirassés qui n'ont rien fait pendant la guerre," has come round to less extreme and more sensible views since he felt the supreme responsibility on his shoulders and has come into closer personal contact with the comprehensive and thorny problem of sea power. With the best-informed naval opinion he merely holds that pre-war battleship designs no longer meet present requirements, and are in need of a thorough revising. Far from considering the big armored fighting ship as a thing

of the past, he has given every encouragement to the ballistic and explosive experiments and researches conducted under the supervision of Artillery General Charbonnier with a view to maintaining France's lead in the ballistic line.

President Millerand and Premier Leygues are agreed with Minister Landry and our acting First Sea Lord, Admiral Salaun, that France must finally give up all thought of competing for size with either Great Britain or the United States of America, but nevertheless that she has the duty and means of remaining a first-class power and of commanding the respect of her neighbors, provided she (1) keeps a fleet superior in quality and efficiency to any continental rival and utilizes (2) her unique strategic assets to eventually ensure her command of the most important European sea routes, besides (3) acquiring a predominance in the field of invention, where Frenchmen have all along been pioneers. The unreliable and changing politics of our first Latin sister, Italy, her rumored alliance with our second Latin sister, Spain, that is preparing a programme of three 25,000-ton battleships, five 6000-ton cruisers, and 160 destroyers and submarines to be ready in 1927, are developments having a direct influence on the Mediterranean situation, despite the friendly sentiments of Frenchmen for their Southern neighbors. As noted by Premier Loygues, peace is only secure so long as there is sufficient "force au service du droit" ("Right supported by might").

The five scouts, surrendered by Bocheland and Austria, which the French Navy is authorized to put in commission, have been renamed Strasbourg, Metz, Mulhouse, Colmar, and Thionville, after cities of recuperated Alsace-Lorraine. There is everything to praise in this fitting nomenclature that will call the attention of the new provinces to the navy, and also in the decision to name surrendered Boche flotilla units after "marine morts pour la patrie dans des circonstances particulièrement héroiques." The largest destroyers revive the memory of Rear-Admiral Senès, who perished in the torpedoed Gambetta; of Capt. Rageot de la Touche, who went down with the Bouvet in the Dardanelles; and of the brave Captain Delage, who chose to go down with his ship *Danton* as commanded by the old sea tradition. For some reason the name of the gallant Captain Guépin, who sank in the *Suffren*, is not to be found in this list of posthumous honors that even includes heroic petty officers and ordinary seamen like Maitres Jean Corre, Second-Maitre Pierre-Durand, Matelot-Leblanc. In every ship an inscription will commemorate the brave deeds and the noble example of those heroes of the grande guerre. Thus an epoch-making departure in Gallic naval nomenclature and a sign of the times.—*The Naval and Military Record,* Oct. 6, 1920.

GREAT BRITAIN

LESSONS FROM JUTLAND.—The long delay in issuing to the public the official narrative of the battle of Jutland, as compiled by the Harper Committee, has caused some disappointment. There have been rumors that certain officers who took a leading part in the action are dissatisfied with the official record of their movements, and have insisted on a revision of vital passages in the narrative. The Admiralty, on the other hand, explain the delay on the ground that new and important evidence has come to light. Everyone who has examined the data already published in relation to this action will appreciate the difficulty of preparing an even approximately full and faithful account of the greatest sea fight in history. Hundreds of vessels were present, the slowest of which could travel at a speed of 18 knots, and the major fighting was done by ships of 25 knots speed and more. No human eye could take in this vast kaleidoscope and receive a true impression of it at any given instant, much less follow each of its countless changes and yet retain at the end a clear picture of what had happened at

every stage of the twelve-hour spectacle. To a large extent, no doubt, the uncertainty which prevailed in regard to the principal phases of the battle has been cleared up by inspection and comparison of the ship's logs, but even here the evidence is known to be seriously at variance, and the means of checking it are not always available. On the whole we consider that Captain Harper and his assistants have had a most ungrateful task to perform, and we shall be surprised if the appearance of the narrative does not evoke a very heated controversy.

We do not anticipate any particularly significant disclosures in regard to the tactics of the opposing fleets. Thanks to the books written by Admirals Jellicoe and Scheer respectively, the essential features of the battle are now well known. It began with a fierce action between the British and German battle-cruisers, in which we suffered heavy losses only partially balanced by the damage we inflicted. This phase was succeeded by a brief encounter between the two main bodies, during which our battle fleet established a definite superiority and so mauled the enemy that his subsequent movements were guided solely by a desire to break off the action and escape. The third and concluding phase witnessed the heroic work of our destroyer flotillas, whose incessant attacks confirmed the Germans in their resolution to regain the shelter of their harbors, and incidentally cost them several good ships. Of the sequel little need be said. Scheer, it is true, did make a perfunctory sortie three months later, but by his own admission he was not at all anxious to join battle again. Jutland took the heart out of the German High Sea Fleet. Thereafter it was no more than a passive pawn in the game, and, except for the support it afforded to the U-boats, it had become virtually a negligible factor. In these circumstances we venture to say that the interest attaching to future discussions on the tactics of the battle of Jutland will be mainly academical. It was the third and last of a series of engagements which convinced Germany that she had nothing to hope for from her battle fleet. The first great blow was struck in the Bight on August 28, 1914. the second at the Dogger Bank on January 24, 1915, and the knockout was administered at Jutland. On that fundamental point German and British evidence is entirely in accord.

We do not, however, suggest that the material for investigation has been exhausted. We believe, on the contrary, that lessons of the utmost value may be learned by studying the details of the action. It was especially fruitful in data concerning the relative value of naval weapons. The advantage of superior speed was clearly demonstrated at every stage of the fighting, and, although some remarks made this year by Rear Admiral Chatfield seem to imply that the naval staff is dubious as to the value of very high speed in capital ships, we cannot think that staff opinion has been rightly interpreted on this subject. Where the British fleet proved defective at Jutland was in certain features of equipment. The battle-cruisers were found to be lacking in protection, and three of them succumbed to punishment less severe than their opposite numbers in the German fleet had to endure. It is very desirable that the shortcomings in design which caused the loss of the *Queen Mary*, the *Indefatigable*, and the *Invincible* should be exposed with a view to rectifying them in subsequent construction. So far as is known the behavior of our guns was quite satisfactory. The shooting was so accurate that, ship for ship, the British fleet registered a higher percentage of hits than the enemy, but the advantage of this splendid markmanship was largely nullified by the poor quality of our projectiles. There is not the least doubt that had our shell functioned properly the German battle-cruiser force would have been wiped out. We paid such a grievous price for this lesson that it would be tragic if we failed to profit by it. It raises in an urgent form the question as to whether the design of ordnance material ought not to be left to private manufacturers, the function of the naval officer being confined to laying

down the requirements of the weapons he is to use. This was the principle which Germany adopted with conspicuous success, and we might do worse than take a leaf from her. book.—*The Naval and Military Record,* Sept. 29, 1920.

A NATIONAL AIR POLICY.—The proceedings at the Air Conference have been such as to jusitfy the hope that the foundations of Britain's aerial policy will be well and truly laid. That the government are alive to the vast importance of this subject is attested by the Conference itself, which was arranged by the Air Ministry, and is to be made an annual event. Mr. Winston Churchill assured the delegates that the government intend to help civil aviation by every means in their power. That pledge will do much to dispel the anxiety which had been recently created by the closing down of several well-known aircraft factories and by a growing suspicion that British progress in aviation has been seriously hampered since the war by the unimaginative treatment accorded to commercial flying by officialdom. The intimate relation of civil to military aviation is now obvious to everyone. It is closer even than the relationship between the Royal Navy and the mercantile marine, for, whereas the warship is a type absolutely distinct from the merchantmen, the large aeroplanes now employed on mail and passenger service differ in no essential feature from military machines, and could, in fact, be converted into such at very short notice. Consequently, the dimensions and efficiency of our commercial air service in time of peace will afford a fair index to our air power in case of war. As *The Times* rightly observes, our old insular security is gone, and we must be prepared to defend our existence in the air. The The nearest analogy to air power, it adds, is sea power, and the broad lesson of history is that the nation with the greatest mercantile sea power has been the nation with the greatest naval power. That proposition is incontestable, and it supplies the strongest argument conceivable for encouraging the growth of commercial aviation by every legitimate means.

The raids which German airmen made on this country during the war were not without a certain value, though the effect was very different from that which the enemy anticipated. They caused us but little embarrassment from the military point of view, but they did more than years of propaganda could have done to stimulate public interest in air power. Citizens of every class, and more particularly those who dwelt within the home "war zone," need no reminder of the part that air power is destined to play in the wars of the future. For centuries past we have relied upon the navy to protect us from the horrors of invasion, and within the limits of its power the navy has never failed us. But aviation has bridged the "silver streak" and provided past and future enemies with the means of dealing us overhead blows which the navy cannot parry. Into the problem of national defence a new factor has thus been introduced, and the old formulæ need to be revised accordingly. It is held by some that air warfare is too much of a double-edged weapon ever to come into general use, that the risk—nay, the certainty—of reprisals in kind will deter an opponent, however vindictive, from the raiding cities and industrial centers beyond the war zone proper. But the acceptance of this comforting theory postulates the existence of a formidable air fleet on both sides. Nothing is more certain than that a state deficient in air power would be exposed to merciless raiding by an antagonist who was better equipped in this respect. On the other hand, it is not improbable that two warring states, approximately equal in aerial armaments, would mutually agree to restrict bombing operations to the immediate theatre of war.

Thus, from whatever angle the problem is viewed, the need to build up an adequate reserve of air power is manifest and urgent. The present difficulty is mainly one of finance. Those enterprising firms which have done pioneer work in opening up the home and transmarine airways are entitled to specially considerate treatment, for they have shown the nation

how to protect itself against a new and serious menace. As merchant adventurers of the air they deserve the same sympathy and support that was extended to the seafaring pioneers of Elizabethan days, who made the markets of the world accessible to English commerce and founded British sea-carrying supremacy on an enduring basis. To a certain school of economists the word "subsidy" has an alarming sound. In general the principle of allowing a new industry to find its own feet is a good one. But the case of air traffic is altogether exceptional, bound up as it is with the safety of the realm. It is to be gathered from Mr. Churchill's remarks at the Conference that the Government are ready to grant direct financial aid in developing commercial flying. That is a big point gained, and, now that it has been conceded, the leading aviation firms will have a greater inducement to carry on. The record of the London-Paris air service during the last year is such that the postal authorities need have no qualms about entrusting the conveyance of all first class continental mails to the air line. If this experiment proved a success the system could be gradually developed until in time a perfect network of air routes had been created, giving constant employment to a large number of pilots and machines and encouraging healthy competition among the manufacturers. In this way we should commence to build up that formidable reserve of air power which is no less essential than navy and army to the future security of the nation.—*The Naval and Military Record,* Oct. 20, 1920.

AN ABBREVIATED "HOLIDAY."—Slowly but surely the conviction gains ground that the "naval holiday" which we promised ourselves at the close of the war will be of much shorter duration than was anticipated. Early in 1919 it was, we believe, suggested by Mr. A. Hurd that naval shipbuilding might be suspended for five years without endangering British supremacy. At that time there was some reason to hope that the large programmes in course of execution in the United States and Japan would be arrested, or at any rate modified, as the result of an international agreement for the limitation of armaments. That hope has not been fulfilled, and the two Powers in question are steadily enlarging their naval establishments. It is therefore of interest to consider how our relative standing would be affected if we forbore to lay down any new ships until January, 1924, *i. e.,* the date on which the proposed five years' "holiday" would expire. By then we should no longer be supreme in capital ships, which, according to the Admiralty, still constitute the backbone of naval power. The United States Navy would enjoy a marked preponderance in this type. Its battle fleet, although but little stronger numerically, would consist of more modern material, and in gun power would be from 50 to 70 per cent superior to ours. By the same date the Japanese Navy will include eight ships—four battleships and four battle-cruisers—of a more formidable type than anything we possess. When it is remembered that these two navies are at the present time building a total of 24 capital ships, all of which are to be armed with 16-inch guns, it must be perfectly obvious that British supremacy is fast disappearing.—*The Naval and Military Record,* Oct. 13, 1920.

AIRCRAFT CARRIERS.—Pursuant to orders, the new aircraft-carrier *Eagle,* which has been undergoing trials in the channel since entering into commission last April, is now joining the Atlantic fleet in place of the *Argus* while the latter is refitted at Devonport. While nothing of an official nature has been given out as to the trials of the *Eagle,* it is freely rumored that the ship has been found lacking in qualities which are essential to the function she is designed to perform. Originally begun as a battleship—a sister to H. M. S. *Canada,* lately resold to Chile—the decision to convert her into a carrier of aircraft was taken at a time when there was rather a craze for this type of vessel, but in her case the inspiration was not a happy one. The first requirement of any ship intended to work with aircraft is high speed, and this the *Eagle* does not possess. She is also

criticized as too large, unwieldy, and expensive. What she has cost the country up to now remains a secret, but rumor has it that the bill falls not far short of four millions. At any rate, the fleet flying men are not enamored of their latest acquisition, and it is believed that the idea of employing her permanently as a substitute for the *Argus*—a remarkably successful ship—has been dropped. The Chilean Government, it is said, has offered to purchase her, provided she is reconstructed as a battleship. If this work could be done without entirely swallowing up the purchase price it might be worth while to accept the offer.—*The Naval and Military Record,* Oct. 6, 1920.

THE LIGHT CRUISER "RALEIGH."—H. M. S. *Raleigh,* a light cruiser of what is officially designated the "improved *Birmingham*" class, reached Devonport last month to be prepared for commissioning as flagship on the North America and West Indies station. The designs, prepared in the summer of 1915, were based on the principles of an extensive cruising radius, ability to steam far and fast in any part of the navigable globe, and an unusually powerful armament. The dimensions, etc., are as follows: Length between perpendiculars, 565 ft.; length overall, 605 ft.; breadth, extreme, 65 ft.; mean load draught, 17 ft. 3-inch; displacement, 9750 tons; shaft horse-power, 60,000; speed at load draught, 30 knots; fuel at load draught, 1000 tons; maximum fuel capacity, 1500 tons of oil plus 800 tons of coal. Armament: Seven 7.5-inch B. L., twelve 3-inch (including four anti-aircraft) Q. F. guns, six 21-inch torpedo tubes. Protection: Side amidships, 3 inch-2 inch.; forward and aft, 2½ inch-1½ inch; 1 inch after bulkhead, 3 inch conning tower, 1 inch upper deck amidship, 1 inch lower deck aft. These ships were the first light cruisers to be provided with bulges as a protection against torpedo attack. The bulges are of a modified form, 10 ft. deep; but owing to the slope inboard of the side of the hull the projections have no serious effect on speed. A perpendicular from the top of the side would just touch the edge of the bulge amidships.

The ships, it will be observed, were originally designed to burn oil and coal—this in view of the possibility that oil supplies might not be always available in the more remote ports of the world. Subsequently, however, this arrangement was altered in three ships of the class to oil only, the original power of 60,000 shaft horse-power on the four-shaft geared turbine installation being increased up to about 70,000 shaft horse-power in consequence of the change. The *Raleigh* has eight oil-fired boilers, each with a heating surface of 7650 square feet, and four boilers fired either by coal or by oil, each having a heating surface of 4675 square feet and a grate area of 77 square feet. It is estimated that, with only four coal-burning boilers in use, enough steam would be generated to propel the ship at a moderate speed. The turbines are of the Brown-Curtis impulse type, the high-pressure turbine running at 3200 revolutions per minute at full power and the low-pressure 2150 revolutions, geared down to give a speed of 420 revolutions per minute to the four propellers. The boilers and turbines, with their gearing, form a remarkably compact power unit, and take up little more than one-third of the total length of the ship. The auxiliary plant includes fifteen Weir feed pumps and twelve steam-driven fans for the three boiler-rooms. The oil-fuel pumps, heaters, and filters are situated in the boiler-rooms. Each engine-room contains two Allen dynamos of 105 kilowatts, driven by compound reciprocating engines, for generating the electric power and light. The main steering engines are of the three-cylinder type. The auxiliary steering is on the Hele-Shaw electric system. As the *Raleigh* is to serve as a flagship in tropical climates, extra refrigerating machinery has been installed.

The official trials of the *Raleigh* began on September 5. Final progressive trials, working up to full power runs of four hours' duration, were carried out on three successive days, at powers varying from 3000 up to the maximum of 71,350 shaft horse-powers, at which latter figure a speed

of 31 knots was achieved, which is considerably better than the performance of the two earlier ships of the class, *Hawkins* and *Vindictive*, in which four boilers are coal-fired. At full power the *Hawkins* made 29.5 knots, while the *Vindictive*, with a maximum of 63,600 shaft horse-power, touched 29.12 knots. With regard to the general behavior of the *Raleigh's* machinery, Messrs. Beardmore, the builders, write to us as follows: "On these trials the cruising turbines came in for severe testing, and in the matter of steam and oil consumption they showed a saving of oil fuel of some 15 to 20 per cent at the economical cruising speed of 16 to 17 knots. This was due to the extra expansion of steam when utilizing the cruising turbine at the forward end of the high-pressure turbine. The very notable performance of the machinery was revealed by the fact that which one-half of the nominal power, *i. e.*, with 35,000 shaft horsepower, a speed of 28 knots was actually attained on the course. H. M. S. *Raleigh* turns out to be a remarkably steady gun platform, and in the matter of vibration it was hard to tell that such high speeds were being attained. The machinery performed admirably, and the noise of the single-reduction double helical gearing was not obtrusive."

The ships of this type represent a distinct advance in the development of the protected cruiser. "Light cruiser" is really a misnomer when applied to vessels of nearly 10,000 tons; on the other hand, the fact that the *Raleigh* and her sisters have 3-inch plating on the sides does not justify their inclusion in the armored cruiser category. As protected cruisers they are very remarkable ships. Their speed would enable them to run down any light cruiser completed to the present date, and their armament would make them dangerous opponents to anything less than a capital ship. Although they were built primarily for the protection of ocean trade, they would be no less formidable in the aggressive *rôle* of commerce destroyers by virtue of their high speed, extensive radius, and powerful artillery.

For the next few years, at least, the *Raleigh* and her sisters will be the most powerful protected cruisers in the world. In speed they may be surpassed by the ten American vessels now being built, which are designed for 35 knots, but in every other quality the British ships will be far superior. This fact has been so far recognized abroad that the General Board of the United States Navy is advocating a new type of cruiser with a main armament of 8-inch guns; while the French authorities are said to be considering designs for a group of light cruisers with a 7.6-inch armament. The *Raleighs* are, perhaps, open to criticism on the score of cost, for £1,500,000 is without doubt a large sum to pay for a cruising ship. Still, considering the present depreciation in money values, their cost compares not unfavorably with that of the *County* class, which averaged £775,000 per ship. We would like to add that, in our opinion, the design of the *Raleigh* class is a remarkably successful one, reflecting great credit on the skill and enterprise of the Naval Construction Department of the Admiralty.—*The Engineer*, Oct. 15, 1920.

SHIPPING IN WAR TIME.—It may certainly be hoped that the experience gained by the government in handling shipping will be embodied in a suitable form and kept up to date by the Imperial Defence Committee for use in any future emergency. Such an emergency, it may be hoped, is in the far distant future, but the important thing is to be prepared. For the general public, one excellent means of knowing how great a part was played in the late struggle by our great shipping concerns is in the series of books which some of them have issued containing records of their war work, and to which various references have been made in these columns. Doubtless other steamship companies will be putting out their war narratives, for material is plentiful enough. For example, the Clan Line, with the *Clan McTavish*, and the Pacific Steam Navigation Co., with the *Ortega*, indicate how interesting these may be. The spirited fight

of the former with the *Möewe,* the disguised German raider, in January, 1916, ought certainly to be recorded in some permanent manner; and so, too, should the ingenuity and resource shown by the crew of the *Ortega* in escaping from the *Dresden* by running into the Magellan Straits.—*The Army and Navy Gazette,* Oct. 2, 1920.

JAPAN

STRATEGY IN THE PACIFIC.—A message from Tokio reports that Japan is engaged on a program of submarine construction, and that, pending the erection of buildings ashore, the old battleship *Shikishima* has been commissioned as depot ship for the submarine flotilla. It was first announced in our columns, early this year, that the Japanese authorities had decided to lay down a number of big submersible vessels, closely modelled on the notorious German U-kreuzer type, one of which was ceded to Japan by the Allied Naval Council. The largest completed vessel of this type was the *U-142,* displacing 2158 tons, with a cruising radius of 20,000 miles and a maximum speed on the surface of 18 knots. She was armed with six torpedo tubes and two 5.9-inch guns, and carried a complement of about 80. It is fairly obvious that a submersible of this description would be better adapted to operations in the Pacific than in the comparatively restricted waters of the war-time submarine zone. There is no precise information as to the characteristics of the large Japanese submersibles now in hand, but unofficial reports are such as to suggest that their design has been influenced by the requirements of commerce destruction. Since Japan is not building her fleet for fun, her naval program is naturally based upon the peculiar strategic conditions that would prevail in the event of war with a first-class power, such as the United States. The rapid growth of the American mercantile marine has made the latter country more vulnerable to naval attack than she has been for 60 years, and in case of war with an opponent who was well supplied with fast light cruisers and ocean-going submarines of great endurance she would almost certainly suffer heavy losses in shipping. It is no secret that the progress of the Japanese naval program, coupled with the recent recrudescence of friction on the subject of Japanese immigration into California, is causing perturbation in Washington. Mr. Daniels and Admiral Benson still consider it expedient to utilize the bogey of British "navalism" as an argument for enlarging the United States fleet, but we doubt whether any shrewd American is deceived as to the true purpose, underlying the big building programs adopted by his government in recent years.—*The Naval and Military Record,* Sept. 29, 1920.

JAPAN'S FINANCIAL CRISIS.—If stupendous growth can ever be really healthy, Japan enjoyed her healthiest development during the war. The call for exports was unlimited. The possibilities of import were strictly limited, and Japan had, as far as possible, to supply her own needs while catering to the needs of other nations. There were wild extravagancies by certain profiteers. Freights at 1500 shillings a ton brought prosperity to the geisha as well as to the shipowner, but on the whole it was an industrious, frugal and highly remunerative life.

One shadow oppressed it—the fear that even the best of wars must end. False reports caused minor panics, but these "Wolf!" cries soon ceased to have any affect. During the latter days of the German retreat, when it became certain that the end was near, some of the bigger men unloaded, and this caused a heavy slump when the armistice was signed, but it was the realization of this unloading rather than the armistice itself which caused the depression, and it quickly passed away. It soon became apparent that business was going to be better than ever—that, until Europe's industries were reconstructed, the world wanted everything Japan could make.

But Japan was near the end of her manufacturing resources. Her machinery was worn out, and her own natural products were few. It was necessary to refit. Money was plentiful, and there now became a remarkable swing around in the balance of trade. This balance of trade, it may be mentioned, had for years been a nightmare to Japanese statesmen. Japan was a debtor country, but she imported more than she exported, nor could the most unreasonable of tariffs bring about the "favorable" balance desired. How the war and the boom after the war affected this balance may be best seen in a few figures, as shown in the following table:

TABLE SHOWING WAR'S EFFECTS ON TRADE BALANCE OF JAPAN

	Imports Yen	Exports Yen	Excess Yen
1914	595,735,000	591,101,000	*4,634,000
1915	532,450,000	708,306,000	†165,846,000
1916	756,428,000	1,127,468,000	†371,040,000
1917	1,035,811,000	1,603,005,000	†567,194,000
1918	1,668,143,000	1,962,100,000	†293,957,000
1919	2,173,460,000	2,098,873,000	*74,587,000
1920	‡1,617,404,000	1,138,836,000	*478,568,000

* Imports. † Exports. ‡ Six months.

In this table we have in six months an excess of imports not so far short of the value of the whole export trade in the year preceding the war. Yet no small part of it was a provident outlay, spent on raw materials and the machinery for handling them. There was this notable development, however: First, whatever was required was bought regardless of cost; secondly, there was a passion for capitalization; and thirdly, there was an enormous increase in wages. Moreover, the growing figures in the trade totals represent much more an increase in price than in quantity.

THE CAUSES AT WORK.—The first of these items—purchase regardless of price—brought about the chief shock when the inevitable slump came last March, for there was some danger that the whole fabric of finance would collapse through the large advances made on depreciated goods being irrecoverable. In illustration of the passion for capitalization it will suffice here to cite the agitations conducted by shareholders in the Nippon Yusen Kaisha and the Kanegafuchi spinning mills (perhaps the two soundest and most solidly remunerative concerns in the whole of Japan) to force a reluctant directorate to increase capital when they had in hand more cash than they could spend. With these examples of how the fires of speculation were fanned amid the solid timbers, the rapid envelopment of the rest of the structure in devouring speculation may be imagined.

The third factor—the rise of wages—was in some respects the most serious of all. Japan's manufacturers got through their most prosperous time before the labor problem became serious. In August, 1918, the people, exasperated at the success of the rice brokers in forcing up the price of rice far above the increase in wages, rioted all over the country. But the post-war boom was just then at its beginning. It was realized that labor unrest during this period would ruin everything, and since then it has been a case of "ask and have." The orderly strike has been developed into a fine art, and during 1919 there was an all-round increase in wages so extraordinary that in some lines of skilled workmanship wages are in excess of the pre-war British level, without half the British efficiency. The fact that costs of production in Japan had become higher than in America was attracting serious attention when the slump came. There had, however, been no more food riots, though prices were higher than ever.

AMERICAN DEMAND FOR SILK.—No single factor contributed so largely to the Japanese boom as the American demand for raw silk. Many a

year it has saved the financial situation, and during the past six years, while it has doubled in quantity, it has more than doubled in price. These figures of the export of raw silk to the United States are illuminative:

	(Roughly 1 lb.) Kin	Yen
1913	13,340,000	125,909,000
1919	27,529,000	600,843,000
1920 (six months)	7,990,000	242,557,000

In spite of the heavy falling off in quantity it will be seen that the price is more than satisfactory. Of silk exports in 1914 the average price was 9 yen per kin. In 1919 it was 21 yen. For the first six months of 1920 it was 30 yen. And this figure of 30 yen is the more remarkable because it includes the months of May and June, in which exports averaged, respectively, 24 yen and 17 yen per kin, besides declining in quantity to less than one-third of the exports of the prosperous months. Nothing contributed more to Japan's present embarrassments, therefore, than the discovery by American consumers that they were paying more than they liked to for "luxury" goods.

The other great industries of cotton manufacture and shipbuilding have also played an important part, and their tribulations have contributed largely to the present general depression. In shipbuilding the decline has not been nearly so great as might be assumed from the fact that of 160 shipyards over 120 are wiped out. These 120 were nearly all very small concerns, many of them constructors of wooden ships that often did not survive one voyage. The order taken for the United States Shipping Board (the famous "ships for steel" contract) has held up the shipbuilding industry, and now that a slump has become unavoidable the enormous navy estimates passed by the extraordinary session of the Imperial Diet in July insure ample work in all the principal yards for a long time to come. Much more serious in connection with shipping is the loss of the war monopoly, the entry of American competition and the decline in freights. Apart from the favorable balance of trade, the high freights earned by Japanese ships during the boom in themselves an enormous revenue—though visible only in a growing fleet, great office blocks, and 100 per cent dividends.

There is now a prospect of much idle shipping. The running of Japanese ships, owing to the forcing up of wages, is no longer cheap. It is said to come between British and American. And there is a bitter struggle now going on over the reduction of wages and the increasing employment of Chinese. The California attitude toward the Japanese farmer is mild and benevolent compared with the Japanese sailor's attitude toward the Chinese interloper.

PROFITEERING IN COTTON GOODS.—As regards the part the cotton industry has played in the depression the Chinese boycott has been much exaggerated. In no great industry was the profiteering so gross as in cotton. The brokers had the whole yarn trade in their own hands, making long forward contracts with the mills and combining to keep up prices. The falling off in the export of yarn in China was due less to the boycott than to this exaltation of price. Exports were, of course, much cheaper than domestic prices (that is the case with nearly all Japanese products), but they were not cheap enough. However, it was one of the complications of the trade that the brokers sold the yarn to the weavers for less than it cost them, and took the product at their own price, and as the increase in exportation of piece goods to China increased vastly more than the export of yarn declined, it is obvious that the boycott, though it undoubtedly worried certain retailers in China, had no very profound influence on trade.

The immediate cause of the slump was the Bank of Japan's action in refusing to lend any more money to the private banks, and its calling in of

the loans falling due. There have been some petty scandals about influential people having the tip to sell out, but that is a detail. The Bank of Japan was wise in the promptitude with which it recognized the fact that American and European prices were going to suffer convulsions. Japan's profits during the war and the post-war boom would amply cover all her commitments, but the orders placed abroad for goods, although largely consisting of equipment for fresh industry, were placed regardless of price. They could hardly be checked while the export trade was also increasing, and while the prices of Japan's chief exports were even more extravagantly in excess of the normal than were those of her imports, the point had been reached where any stoppage in returns (at inflated prices) meant disaster. Cotton and silk were already fluctuating wildly, and the efflorescence of small shipyards had disappeared from the coasts. The Bank of Japan was not a moment too soon.

EFFORTS AT READJUSTMENT.—As for the remedies sought they have been merely relaxations of the bank's decree, with corresponding relaxations filtering downward to the proletariat. The Bank of Japan has been less strict than it promised. A few millions here and a few millions there have been lent for the purpose of stopping a sudden rot, but in the main those concerned have been left to deal in their own way with the situation created by a sudden fall in prices and a cutting off of credit.

Most notable have been the movements of the yarn brokers, whose hold over the mills has already been described. They have seen the price of their commodity decline over 50 per cent in a couple of months, and though they all became millionaires during the boom they are unwilling to disgorge. Many, of course, have not preserved the wherewithal to disgorge, and one or two have sought the popular short cut out of trouble "with a bare bodkin."

Owing to the complications of the trade the mills find it very difficult to dispense with the brokers, greedy parasites as they are, so they have, after much argument, submitted to the following: Sixty-five per cent of their contracts made when yarn was well over 700 yen a bale are being revised to the price on July 9, when it was not much more than 300 yen. The price as between mill and broker was always much less than the market price, so it is impossible to gather any very precise idea of the amount involved, but it is a 65 per cent evasion of contract. Even at this there are some defaulters, and the rest wriggle powerfully to avoid their responsibility and to shift this burden also to the mills.

Meanwhile the mills have to pay their full contract price for forward contracts of raw cotton, and in many cases it is these very brokers dodging their 65 per cent who are insisting on the fulfillment of contracts in respect of raw cotton. The mills have large reserves, can raise mortgages, are working short time, and can cut wages. Against all these resources the broker can only cut his throat. So the shareholders and the work people pay. Similar compromises have been made in many trades, the flannelette compromise being one in which there has been particularly acrimonious discussion. "Compromise" Japan always means the partial foregoing of a legal claim or the partial submission to an illegal one. Fertilizer also provides a salient example of the compromise system, and it is mentioned here because the fertilizer trade exhibits very markedly another of the expedients adopted in order to ameliorate the depression. Sulphate of ammonia and Chilean nitre are being exported to any customer abroad who will offer a passable price. The idea is not to be content with a small profit or even to cut a loss, but to create such a shortage in Japan that a good profit may, after all, be wrung from the consumer. Pulp has been re-exported in large quantities, and many other commodities. Then there are the re-exports of goods of which the importer simply cannot (or will not) take delivery, the more honorable of such firms asking the seller to dispose of the goods elsewhere at their risk and expense.

MANY ORDERS CANCELLED.—And, of course, cancellations have been enormous. It has to be remembered that the stoppage came just when buying was in full state. Though America had more than taken the place of Britain as a supplier to Japan, it is probable that Britain has suffered more by cancellations. The falling off in British exports to Japan was more in consequence of the ruin of British industries by the war than for lack of orders. Since the war orders have been pouring into Britain in vast quantities, in spite of it being impossible to promise early delivery. Just as British industry was getting into its stride again for the execution of these orders they were all cancelled. It is stated (in the Japanese press) that two months' cancellations of orders for British woolens amount to 60,000,000 yen.

The end is not yet. The smaller concerns have mostly cut their losses, and are beginning to move again, but the bigger ones are still in the quagmire. Nobody fulfills his contracts, and so the losses are passed on, but there have been few big failures, and the biggest firms are often in the most precarious position. One of the largest lately refused to take delivery of a consignment of so easily disposed of and so profitable a commodity as heroin.

Meanwhile the banks, by their extreme caution, have long since emerged from their penniless condition, and are, while refusing the safest advances, complaining of the lack of profitable fields for the investment of funds. At this moment comes an issue of government bonds, and the Siberian adventure makes it certain that these issues will greatly increase in the near future. This leaves it an open question how far it was pure astuteness and how far a warning of military necessities which caused the Bank of Japan to close down at the moment it did.—*N. Y. Times Current History Magazine*, November, 1920.

UNITED STATES

OUR DIVIDED NAVY.—The glowing announcement given out from Washington on July 27 of the great feats that are to be performed near Panama when our Atlantic and Pacific fleets come together in January shows a conception of naval power that is not only deplorable but dangerous. It evidences a belief on the part of the persons who made the announcement that naval power consists mainly, if not wholly, in a large aggregation of large ships carrying large guns and torpedoes. If it does not evidence this state of mind, it evidences an attempt to persuade the people of the United States that such are the constituents of naval power.

The idea that mere aggregations of men and material constitute fighting forces is as old as history and is one of the most serious mistakes that history records. Under the influence of such ideas the Persians sent their enormous hordes to fight against Alexander; the savages of Gaul hurled themselves against the phalanxes of Cæsar, and the Austrians and Piedmontese took the field against Napoleon. Under the influence of ideas exactly the reverse. Alexander, Cæsar and Napoleon crushed the unskillfully trained hordes that came against them. Under the influence of such ideas as the announcement from Washington discloses, all the inefficiently trained and led forces in all the wars of history went down. Under the influence of ideas exactly the reverse, all the great commanders of history have led their armies and fleets to victory.

If there is any one fact that history proves more clearly than any other fact, it is that any fighting force, in order to serve the purpose for which its nation maintains it, must be drilled as a single fighting force. The reason that a club is so effective as a weapon is because it is not a loose aggregation of molecules, weakly held together, but a compact and coherent mass, all of whose particles are firmly held together, each part supporting every other part and forming together a single unit, which can be directed to a given definite purpose. The whole effort of organization and training is

NAVY DEPARTMENT—BUREAU OF CONSTRUCTION AND REPAIR

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—DEGREE OF COMPLETION, AS REPORTED OCTOBER 31, 1920

Type, number and name	Contractor	Per cent of completion, Nov. 1, 1920, Total	Nov. 1, 1920, On ship	Oct. 1, 1920, Total	Oct. 1, 1920, On ship
Battleships					
44 California	Mare Island Navy Yard	94.5	93.2	94.2	92.6
45 Colorado	New York S. B. Cpn.	61.3	55.9	59.5	54.2
46 Maryland	Newport News S. B. & D. D. Co.	84.	83.	81.6	80.4
47 Washington	New York S. B. Cpn.	52.7	43.4	51.5	41.9
48 West Virginia	Newport News S. B. & D. D. Co.	35.5	22.5	33.5	19.5
49 South Dakota	New York Navy Yard	16.2	8.	15.4	7.6
50 Indiana	New York Navy Yard	12.8	4.6	12.1	4.3
51 Montana	Mare Island Navy Yard	13.2	6.2	12.6	5.
52 North Carolina	Norfolk Navy Yard	17.4	10.3	15.4	9.4
53 Iowa	Newport News S. B. & D. D. Co.	9.4	6.6	7.7	4.6
54 Massachusetts	Beth. S. B. Cpn. (Fore River)	....	....	....	....
Battle Cruisers					
1 Lexington	Beth. S. B. Cpn. (Fore River)	3.2	.4	2.1	.3
2 Constellation	Newport News S. B. & D. D. Co.	2.2	.6	1.7	.3
3 Saratoga	New York S. B. Cpn.	5.8	3.2	4.2	1.1
4 Ranger	Newport News S. B. & D. D. Co.	8.	.2	.8	.2
5 Constitution	Phila. Navy Yard	1.2	.4	1.1	.4
6 United States	Phila. Navy Yard	1.2	.4	1.1	.4
Scout Cruisers					
4	Todd D. D. & Const. Cpn.	78.1	68 9	70.1	61.4
5	Todd D. D. & Const. Cpn.	68.	62.7	61.4	52.6
6	Todd D. D. & Const. Cpn.	45.8	26.8	40.6	19.6
7	Beth. S. B. Cpn. (Fore River)	23.	12.	18.2	8.7
8	Beth. S. B. Cpn. (Fore River)	21.4	10.4	17.	7.5
9	Wm. Cramp & Sons Co.	55.	......	53.	....
10	Wm. Cramp & Sons Co.	54.	......	52.	....
11	Wm. Cramp & Sons Co.	32.	......	29.	....
12	Wm. Cramp & Sons Co.	31.	......	29.	....
13	Wm. Cramp & Sons Co.	24.	......	22.	....
Miscellaneous					
Fuel Ship No. 17, Neches	Boston Navy Yard	Comm. 10/25/20		98.5	98.5
Fuel Ship No. 18, Pecos	Boston Navy Yard	42.5	39.	39.	34.5
Gunboat No. 22	Charleston Navy Yard	37.1	25.3	61.4	49.4
Hospital Ship No. 1, Relief	Phila. Navy Yard	99.	98.8	98.5	98.
Amm. Ship No. 2, Nitro	Puget Sound Navy Yard	99.4	98.2	99.2	97.6
Rep. Ship No. 1, Medusa	Puget Sound Navy Yard	42.7	32.	42.	35.
Destroyer Tender No. 3, Dobbin	Phila. Navy Yard	36.5	36.	31.5	31.
Dest. Tender No. 4, Whitney	Boston Navy Yard	5.	2.	3.	1.5
Sub. Tender No. 3, Holland	Puget Sound Navy Yard	7.5	....	6.	....
Aircraft Tender, Wright	Tietjen & Lang	65.	....	....	....

There are in addition to the above, under various stages of construction 45 destroyers, 47 submarines, and 2 sea-going tugs.

There were delivered during October, 1 fuel ship (*Neches*), 7 destroyers, 1 submarine and 1 sea-going tug.

Authorized but not under construction or contract, 1 transport, 12 destroyers and 7 submarines.

to make the various component parts of a fighting force to resemble a club as nearly as possible; to the end that in the hands of its commander it can be directed as a unit to a single definite purpose and inflict a definite blow at a definite point.

The smaller an organization is, the more easily this unity of purpose and directness of effort can be attained. But even with the nine men who constitute a baseball team or the eleven men that constitute a football team, a great deal of the most intensive effort is required, despite the fact that very few men are to be trained to act together, and that the material which they work with is of the simplest possible description, consisting merely of a ball and a bat. The greater the number of men in any organization and the greater the skill required to manage the mechanism, the greater the difficulty, of course, in accomplishing the unity of effort needed. Not only this, but the greater the difference in the ultimate results which an organization can accomplish, if it be well trained or not trained. This means that the larger and more important an organization becomes the greater are the difficulties met in achieving unity of effort, but the greater the necessity for achieving it.

The most powerful organizations in the world are fleets. Without doubt the British fleet is the most powerful military organization in the world. It is the most powerful not only because it has the greatest number of fighting ships and fighting men, but because the influence of Admiral Lord Fisher, reinforced by the effects of the great war, have made the British fleet so compact, so coherent, so thoroughly trained, that all its units are simply parts of one great unit that can be used as a veritable club against Great Britain's enemies.

In other words, the British Navy is an organization that was not thrown together haphazard and thoughtlessly, but an organism embodying not only mere material strength but brains. The direction of the British Navy has been able and skillful. Can this last remark be made about the United States Navy?

If any thoughful man goes on board any of our ships and observes the skill and precision with which all work is done, he would surely declare in the affirmative. But the same thoughtful man, with further knowledge of the operations of the Navy Department itself, would surely answer in the negative. He would surely answer in the negative because he would see that, although the individual ships are good materially, and although there are many good ships of all classes, yet the ships are so deficient in personnel, and the personnel therefore have so little opportunity for really performing their work effectively, that the ships themselves are not effective fighting units. He would find also that the navy as a whole is weak in the place where it is most dangerous for it to be weak, that is, at the head. He would find (doubtless to his great surprise) that although the United States has a navy, it has no fleet!

This thoughful observer would find that, instead of having one grand fleet, as Great Britain has, it has two fleets, neither of which is grand at all. He would find that not only are our naval vessels put into two divided fleets, instead of into one grand fleet, but that these two fleets are out of supporting distance of each other and are, in fact, in two separate oceans—the Atlantic and the Pacific. He would find that, despite the facts that the United States Navy was the first to establish a Naval War College, and that this Naval War College is admitted to be the best in the world. and despite the fact that the navy includes scores of officers who have graduated from this college and many other officers who have taken its correspondence course—yet nevertheless the teachings of this War College are openly and flagrantly violated in the management of the fighting force of the navy!

The most open and flagrant violation of the teachings of the Naval War College is the dividing of the American naval force into two fleets, unsupported by each other, unable to maneuver together continuously as one

fleet, and unable, therefore, to fulfill the purpose for which they were created and are now maintained by the United States.

Experience has shown that a year is all too short a time in which to carry out the exercises and maneuvers necessary to make a fleet efficient as a real fighting force; yet the Navy Department calmly announces that not only are the two fleets to remain separated, but that even their junction in January, 1921, is to be so brief that "exercises and drills will be simple and mainly of a competitive nature, including unofficial athletic competitions between representatives of the two fleets and of individual ships. The main object of the mobilization will be to give officers and men an opportunity to compare notes and meet for a few weeks of good-natured rivalry."

Such a naval junket is a senseless waste of government money; and any attempt to persuade the people that it constitutes a useful mobilization is to make fun of naval training.—*N. Y. Times.*

WANTED—A NAVAL POLICY.—We have a considerable navy, somewhat unbalanced, and a building program for the near future, but the navy is undermanned. Ships no more constitute a navy than guns constitute an army, or land and implements a producing farm or vaults and currency a going bank.

We have more than one naval problem, notably the division of the fleet and the question of the authority of a board of naval experts or of a civilian secretary of the navy for naval operations.

The presidential campaign just closed, for reasons of political prudence perhaps, in both party platforms and public discussion, turned upon other issues. The administration-elect is without a popular mandate concerning military policy Therefore, it behooves the friends of the navy and of intelligent preparedness to busy themselves in the shaping of a naval policy.

By the time this is read the result of the election will be known. Immediately thereafter the ambitious men of the successful party and their friends quite naturally will begin planning for preferment, and party leaders will begin to formulate policies. Between the election and the inauguration the course of the new administration will be laid. From November to March is the period of determination. What the navy is to become in the next four years will depend upon the man who is soon to be selected for Secretary of the Navy, upon the consideration given to naval affairs by the new President and his counsellors, and upon the judgment of the party leaders in Congress. Civilian opinion and political expediency will control, but will be subject to those proper influences which intelligent presentation can readily exercise.

Notwithstanding the high hopes and the fair prospects of some sort of international concert to promote peace, it is plain to all clear-seeing men that world conditions at the moment and in the near future give no promise of American isolation and immunity from strife. Our new foreign trade, our merchant marine policy, our Pacific coast racial troubles, our continuing participation in German occupation, our foreign loans, our frequently expressed concern in the affairs of China and Russia, our dominant participation in the administration of the affairs of Nicaragua, Santo Domingo and Haiti and Libera—all these interests and responsibilities are prolific of military possibilities. In more than one quarter of the world the United States is viewed with jealousy, suspicion or disappointment. Not every nation wishes us well: some would rejoice to embarrass or cripple us.

While no definite crisis impends, very large eventualities are in the making and they will be influenced in form and direction more by our naval disposition and action than by any other factor which we can control.

Before the World War our naval policy was indifference; during the war it was feverish and wasteful haste; since the war it has been hesita-

tion and reaction. Let us now make it something definite, coherent, consistent, purposeful and persistent, so that our people may become steadfast and the world may know precisely what we intend and what we will maintain.—*Sea Power*, November, 1920.

MERCHANT MARINE

PRESIDENT-ELECT HARDING'S MESSAGE TO SHIPPING MEN.—Marion, Ohio, Nov. 3.—The phenomenal emergence of a great American merchant marine is one of the most striking economic consequences of the World War. In 1914 the total tonnage registered for foreign trade under the American flag was 1,066,000 gross tons; to-day, thanks to the quick sense of the American people as to the critical importance of shipping in the world war, and to the invincible genius of American industry in surmounting governmental delay and administrative inefficiency, there is ready for our flag some 12,500,000 gross tons of sea-going vessels.

This importance of our new merchant marine is not alone that it salvages and puts to use a vast and costly body of war material, nor even that it adds a great new activity to the nation's business life, as well as a wholesome safeguard to the country's security; but, more significant still, it provides the mechanism wherewith we can retain and enlarge the economic vantage-ground in world commerce and world finance which we now enjoy.

A well-equipped merchant marine is a prime essential of successful commerce; it is the best agency of trade development. Nothing else will supply the same enterprises in the search for new markets, nor contribute the same energy in the opening up of new trade routes, nor offer the same encouragement for the investment abroad of our surplus capital. Over-seas transportation in American bottoms is of the root and essence of American commercial expansion.

How urgent is the need will appear if we consider the new position of our country in the world trade. In five years we have changed from a debtor nation, owing the world between four and five billion dollars with a varying annual trade balance, sometimes against us, to a creditor nation to whom the world is in debt on capital account some twelve billion dollars, and to whom is due an annual credit balance certainly as great probably much greater, than our prior debit balance.

It is of the gravest national concern that this changed international position shall not work to the injury of our industrial and agricultural life. Larger exports of merchandise from the debtor to the creditor country remain as the line of least resistance, and to this course we must be prepared to see Europe bending every effort. It is the natural way in which restorations from the war must be wrought.

But a flood of imports from debtor countries intent upon stimulating their productive output and aided, even though undesigned, by an unfavorable foreign exchange, would be a bitter experience for the creditor country. We mean to deal considerately, we want to help, but we do not mean to paralyze America to effect a restoration.

From any such invasion we have a right to be saved. Our new merchant marine will do much to avert it. Supplemented, now and whenever occasion requires, by a cautious revision of the tariff, that, while regardful of our changed international position, will effectually safeguard every phase of American industry and agriculture, the new shipping development will become a potent element in American economic growth without the accompaniment of social injury.

The war caused the rapid expansion of our saltwater transportation facilities and yet, even in 1919, only about 34 per cent of our exports and 50 per cent of our imports were moved under the American flag. We must persist in every measure aiming not only to hold, but to increase the proportion of overseas trade under our flag. It may prove difficult when the merchant fleet of Europe begins to be rehabilitated.

They, like the industries of Europe, will seek to undersell us and in order to keep our shipmasters in business we will find it necessary to extend every possible encouragement, every reasonable preference, to our own.

Convinced as I am that the Panama Canal has a peculair concern to the people of our central valley, it has long been a matter of profound regret to me that the Canal should not have been made one of the great free highways of American trade, whatever may have been the merits of the exigencies which sustained the denial to American trade of special advantages due to American ships by reason of our construction of the Canal. The time surely will come when we must claim for our own country and for the western continents every rightful privilege that may occur by virtue of this linking of the two great oceans.

The Canal ought to be an interest and unity between all the Americas, and I cannot but feel that the policy of a Democratic administration in administering the Canal has failed sadly in realizing these possibilities. It will be our aim to correct the mistakes of the past and to devise a constructive American program for the future.—*The Nautical Gazette,* Nov. 6, 1920.

DRASTIC SHIPPING POLICY CHANGES EXPECTED.—In view of the Republican landslide at the elections Tuesday, which swept Senator Harding and Governor Coolidge into office by record-breaking majorities, and in addition increased the Republicans' strength in both branches of Congress, well-informed shipping men are certain that drastic changes will occur in the Government's marine policy after next March 4.

The statement by President-Elect Harding to *The Nautical Gazette* in this issue will serve to provide the only indication, for the present at least, of what the Republican policy will be. It is believed highly probable that in place of the present Shipping Board, a Department of Marine may be created.—*The Nautical Gazette,* Nov. 6, 1920.

SCHWAB WANTS NAVY CONTROL OF OUR MERCHANT FLEET.—American ship owners must receive government aid of some sort or our mercantile fleets will be worse than useless, according to Charles M. Schwab, who expressed his views in Washington a few days ago.

Assailing present shipping laws as entirely inadequate if the American merchant marine is to maintain the supremacy gained during the war, Mr. Schwab declared that the United States must intervene if our flag is to be kept on the seas.

"My theory is a novel one," he asserted. "I believe that American mercantile shipping should be operated in conjunction with the navy.

"Americans naturally shy at the word 'subsidy,' but, call it what you will, I think that merchant ships should be under the control of the navy. The government should be able to pay the difference between the cost of wages of American and foreign seamen. With our merchant shipping under the control of the navy it would be possible to press these ships into immediate service in the event of war."

Mr. Schwab spoke of the present Panama Canal tolls and said existing treaties should be amended so that Americans would not be forced to pay higher tolls than British merchants. "As an American citizen I am part owner in the Panama Canal," he declared, "and I cannot see why a British subject should get a more advantageous rate than I."—*The Nautical Gazette,* Nov. 6, 1920.

GERMAN VIEW.—Not only has the agreement between the Harriman group and the Hamburg-American Line for the operation of American tonnage on certain of the former German trade routes been subjected to considerable adverse criticism in this country, but it is also being assailed in certain German circles as detrimental to German shipping interests. It is claimed that the arrangement will result in such an intertwining of German and American shipping interests that the former will never be able to

effect a severance from the latter. Our German contemporary Hansa scoffs at any such suggestion, however, and asserts that all fears are groundless. It terms the agreement beneficial to German interests and in no way detrimental to American shipping.—*The Nautical Gazette*, Nov. 6, 1920.

WORLD'S FIVE LARGEST SHIPS.—Following is a list of the five largest ships of the world.

	Length	Breadth	Depth	Gross Tonnage
Bismarck	912	100	57.1	56,000
Leviathan	907.6	100.3	58.2	54,282
Imperator	882.9	98.3	57.1	52,022
Aquitania	868.7	97	49.7	45,647
Olympic	852.5	92.5	59.5	46,359

—*The Nautical Gazette*, Oct. 16, 1920.

AERONAUTICS

AIRCRAFT RESEARCH.—The future of the air service, whether for military or commercial purposes, depends upon the development of aircraft research. The matter is one in which engineers are primarily concerned, for the great improvement in the details of design and construction of aircraft and the power to weigh ratio of the engine are the direct development of their labors. Progress has hitherto followed along conventional lines, but it is evidently the intention of the technical experts of the Air Ministry to approach the problems from a somewhat different standpoint. As development has gone a long way ahead of research, the latter has much leaway to make up, and it will probably be some few years before any great advance in aircraft is made.

The conference arranged by the Air Ministry held in London last week, served the useful purpose of extracting from the Controller-General of Civil Aviation a full exposition of the present position and immediate needs of civil flying, while others including Lord Montagu, Lord Weir, experts in design, and representatives of various scientific and commercial interests, threw some light on the problem from different angles. Sir E. L. Ellington, in a paper entitled *The Present Position of Aircraft Research and Contemplated Developments*, set before the conference the Air Ministry's program of research and experiment.

He enumerated the following qualities as those required in the perfect aeroplane or seaplane: (1) Reliability. (2) Ease of control. (3) Power to land and get out of most restricted places. (4) Good performance, that is high speed, quick climb and a ceiling sufficient to surmount any obstacles likely to be encountered, or to escape the enemy's attack. (5) Cheapness in construction and maintenance.

Reliability, he said, was popularly supposed to be principally a matter of the engine, since a forced landing was usually ascribed to engine failure. As a matter of fact, the majority of engines now in use can be relied upon to stand up for a flight of the duration of the fuel capacity of the machine provided the engine is overhauled at the necessary intervals and care is taken to see that it is in thorough working order before starting. The majority of failures which occur are due to failures of accessories outside the engine itself, such as the petrol supply, lubrication, ignition or water systems.

Sir E. L. Ellington announced that besides endeavoring to obtain improvements in existing engines and in new designs of engines of the normal aero engine types, with a view to improving their life and reliability, the Air Ministry were developing two engines which are quite different from the normal aeronautical engine. The first is a swash plate engine, that is, one in which an inclined disc on the shaft takes the place of the crank in the ordinary engine. Such engines have been used for steering gear in sub-

marine work, and an engine for aeronautical purposes of this type shows considerable promise. It is expected that such an engine of a given weight will develop considerably greater horsepower than one of the usual form, either rotary, radial, Vee or straight, or, conversely, an engine of a given horsepower should be designed for a lower weight.

The advantages of such an engine are that a small proportion of the total weight of a machine will be absorbed in the power unit, and, since the cylinders will lie parallel to the shaft, the shape of the engine will enable the fuselage or nacelle containing it to be so designed as to give a reduced head resistance.

The second engine is a steam turbine; it is generally believed that there is a limit in the size of the cylinders which can be used in the ordinary petrol engine, and that this limit is probably somewhere about 100 horsepower for aero engines. It is also obviously desirable not to increase the number of the cylinders largely, on account of the complication of the design. The British engine with the largest number of cylinders now under construction is the Napier Cup with 16 cylinders, and designed to give 1000 horsepower. If larger engines than this are required for aeronautical purposes, and it seems probable that they will be required, a different type of engine is desirable. The steam turbine seems worth experimenting with. So far, the solutions of all the problems of a steam aero engine have not been found, the main difficulty being the design of an efficient condenser within permissible weights. It is proposed to do away with external ignition altogether, and we understand that the Air Ministry are investigating an engine designed on the Diesel principle which will, of course, render this possible.

It is obvious that aircraft must be easily controlled by the pilot, and that the system and apparatus of control must not throw an undue strain on the physical or mental capacity of the pilot. As long as the machines were small, the problem presented no very great difficulties, but with the advent of the big twin engine machines, and the further development of machines with four or more engines, the demands on the strength of the pilot when moving the large control surfaces through long leads began to approach the physical limit of the ordinary man. The number of engine controls to be worked by the pilot, and the complication of the petrol supply put a very severe strain on the mental capacity of the pilot. In order to reduce the physical effort required by the pilot, control surfaces are balanced, and Sir E. L. Ellington stated that the authorities were endeavoring to reduce the friction in the long leads which actuate them in various ways. Mechanical means of moving the control surfaces are also being developed. For some years now large boat seaplanes have been provided with servomotors for this purpose, and apparatus is being developed at the Royal Aircraft Establishment for automatic mechanical control of machines, both longitudinally and laterally, where use is made of a gyroscope.

Connected with the matter of control of machines is the accessibility of the engines during flight. The advantage of having the engine or engines contained in a central engine-room where they are under the supervision of a mechanic during flight is obvious; the disadvantage that such an arrangement necessitates the driving of the propellers through gears and shafting is equally obvious. In order to investigate this problem, three machines are now under construction or consideration. The first, a boat seaplane, where two propellers in the wings are each driven through gearing and shafts by two engines geared together in the hull. The second is a machine where four engines, all geared together, drive two propellers through gearing and shafts. In this case, one or more engines can be cut out for repair or adjustment, and the remaining engines will all continue to supply power to both propellers. In the third, which is only in the design stage, one or two engines contained in the fuselage drive two propellers in the wings. In such machines the pilot will be relieved of control

of the engines, and will signal his orders to the engine-room by means of a telegraph, in the same way as is done on board ship.

In connection with the case of control, the importance of natural stability becomes apparent. Opinions differ as regards its advantage in fighting machines where great maneuverability is required, but for civil machines there can be no doubt of its importance. In the light of knowledge recently gained, the design of a machine with good natural stability presents no very great difficulty.

CONSTRUCTION AND MAINTENANCE.—In discussing cheapness of construction and maintenance, Sir E. L. Ellington referred to the all-metal machine. Towards the end of the war, he said, the Germans produced an all-metal monoplane with planes of deep section. This enabled the cantilever system to be employed, and all external bracing wires or members to be dispensed with. Corrugated metal sheeting takes the place of fabric in the wing and fuselage coverings. Since the Armistice, a civil passenger carrying machine has been developed by Junker from this which appears to have been most successful in Germany and the U. S. A. Such a machine should require little adjustment, and should not deteriorate from exposure to the weather, though its behavior when exposed to the wide range of temperatures met with in the East requires investigation. Several designers in this country are studying similar designs. If it is found possible to introduce into planes so constructed, elements which can be adjusted in flight at the will of the pilot so as to enable a heavily-loaded machine to rise from a confined aerodrome, and land at a low speed while maintaining a high speed in the air, a very great step will have been made in the development of the aeroplane. In the Junker machine, the engine is contained in the fuselage, following normal practice in this respect. A machine is now being designed in this country in accordance with the Voyewodski patents, in which the depth and structure of the wings is such that engines can be installed within the wing structure. Such model tests as have so far been carried out tend to show as might be expected, that aerodynamically there are great advantage in such a design. It is further suggested that the undercarriage should draw up in flight within the main structure of the machine. Should this prove practicable, we shall be approaching finality in the matter of reduction of resistance in a machine driven by an airscrew.

Another development which aims at increasing the efficiency of aircraft is forced induction for the engine combined with a propeller with adjustable blades. As an aeroplane ascends, the air in which it is moving becomes rarefied, and the volume of oxygen taken into the cylinders at each stroke decreases with a consequent decrease in the power developed during the stroke. By means of forced induction, a greater quantity of air and therefore of oxygen is forced into the cylinders than that which would be forced in by atmospheric pressure. The most promising method of doing this appears to be by means of a fan worked by an exhaust turbine, but so far no turbine has been constructed which will not be burnt by the hot exhaust gases. In this connection it should be pointed out that forced induction is useless without a variable pitch propeller, for by forced induction the engine is made to give out the same horsepower at a height as in the dense atmosphere on the ground, but the propeller which near the ground is working efficiently will require a much greater pitch to work with equal efficiency in the rarefied atmosphere at a height, and conversely. Thus it will be seen that the pitch of a propeller should be different at the various engine and aeroplane speeds if the maximum efficiency of the engine and propeller is to be obtained. If, further, the variable pitch propeller is developed to the point where the blades can be completely reversed, the pilot will be provided with an efficient air brake to assist him

in reducing the speed of landing and pulling up after landing has been effected.

In order to remove the possibility of accidents, mechanical means of starting aero-engines are being developed. These generally are of two kinds:

(1) The starter, which is no part of the machine, but aerodrome equipment.

(2) Starting devices which form an integral part of the machine and its engine.

Satisfactory apparatus of the first-class can now be provided, and two patterns have been tried out successfully.

The short survey of the position of aeronautical research placed before the conference by Sir E. L. Ellington should appeal to those whose study is the science of aviation in its widest sense.—*Engineering and Industrial Management*, Oct. 21, 1920.

THE U. S. AIRSHIP "R-38."—The Navy Department announced on September 22 that latest reports from the officers in charge of the construction of the *R-38* at Bedford, England, state the airship will be completed within the next two months. It is not expected that the voyage to the United States will be made before May, 1921. At that time the hangar at Lakehurst, N. J., will be ready to receive the giant dirigible. With the completion of the Lakehurst hangar, the United States will be in the position to construct airships similar to the *R-38*. At the present time the English hangar is the only one in the world in which such a large dirigible could be built. The *R-38* as well as the Lakehurst hangar are the largest of their kind in the world. The latest figures on the *R-38* give the following facts: Length, 694.5 feet; diameter, 85.5 feet; useful lift, 45 tons; fuel capacity, 32 tons (13 tons available for freight personnel, etc.); consumption per hour, 180 gallons; cruising radius, 5600 knots; speed, 60 knots; speed, cruising, 50 knots; complement, 6 officers, 19 men; motors, 6 Sunbeam Cossack, 350-horse-power; gas volume, 22,724,000 cubic feet hydrogen; dead weight, 33 tons.—*The Aerial Age Weekly*, Oct. 18, 1920.

REVISION OF THE COAST OF NEW JERSEY.—In March, 1920, the Army Air Service photographed the coast line of New Jersey from Cape May to Seabright. A single flight was made using the *K-1* camera. The plane flew at an altitude of 10,000 feet, and under very good air conditions. The camera was mounted in gimbals, with a lead weight at the lowest point to assist in maintaining the optical axis of the camera in vertical position. Level bubbles were placed on the camera to aid in keeping the camera in the proper position. This is the most satisfactory way to suspend the camera, and control its verticality, at the present time. The photographs are being used for a revision of the charts of the Coast of New Jersey. The individual photographs are 18 x 24 cm. in size, and the approximate scale is 1 : 10,000. The photographs are mounted in strip mosaics, for convenience sake, not over four feet in length The length is generally determined by the position of control points. This composite photograph is compared with the topographic sheet of the same area, and control points identified. The scale of the photographic mosaic is determined, and by means of the pantograph, the data are reduced to the scale of the chart, and transferred from the photographs to tracing paper.

The photographing of this 120 miles of coast line took less than two hours time in an aeroplane. The development of the films and printing took two days time of one man. Two rolls of film were used, a total of 183 photographs. The work of interpreting the photographs, assembling mosaics, comparison with topographic sheets, and reduction to the scale of the chart of the outside shore line required 15 days of office work by one engineer.—*Flying*, November.

NAVY AIRSHIPS CRUISED NEARLY 13,000 MILES.—Following the extended account in a New York newspaper of October 23 of the cruise of a squadron of six U. S. N. airships of the Atlantic fleet air force, the navy news bureau at Washington on October 26 followed with an account of the cruise, which began at Philadelphia, the squadron's home station, on November 12, 1919, continuing until June 28, 1920, the object being to test the seaworthiness of the ships. The squadron was in command of Lieut. Commander Bruce G. Leighton, U. S. N., with Lieut. J. H. Hawkins, U. S. N. R. F., second in command. It first cruised down the Atlantic coast to Hampton Roads, and from there to New York City, where the squadron was reinforced by the U. S. S. *Sandpiper*, which was sent ahead of the squadron, towing a lighter, to take care of the ships on their arrival at the different ports of call on the itinerary. The U. S. S. *Shawmut* accompanied the U. S. S. *Sandpiper* as a tender for the squadron. The ports of call included Charleston, S. C.; Savannah, Ga.; Key West, Pensacola, Tampa, Fla.; Guantanamo, Cuba; Cape Haitien, Mole St. Nicholas, Samana Bay, Haiti; Sanchez, San Domingo; San Juan, Ponce and Miraflores, Porto Rico; St. Thomas, Virgin Islands; Kingston, Jamaica; Nuevitas, Cuba; Turtle Harbor, Fernandina, Southport, Fla.; St. Mary's, Ga.; thence to Hampton Roads and back to Philadelphia. During the entire trip the squadron sailed under its own power and covered a distance of 12,731 nautical miles.—*The Aerial Age Weekly*, Oct. 18, 1920.

SIXTEEN SEAPLANES TO COOPERATE WITH ATLANTIC-PACIFIC FLEET—MANEUVERS ON CHILEAN COAST.—Thirty-eight warships and a fleet of the 16 *F-5-L* type seaplanes will comprise the Pacific fleet that will sail January 5 for the Central and South American cruise. Interest in the battle maneuvers is intensified by the fact that it was off the coast of Chile that the first sea battle between the German and British patrol squadrons occurred shortly after the outbreak of the war.

Already the fleet air men are looking forward to the time when they will sail south. The best athletes from the Pacific will contest honors with the Atlantic. Christmas holidays will be spent by the fleet in their respective ports, after which they will be in readiness to sail south. It is expected that there will be a number of *NC* planes received on the North Island Station soon, some of which will possibly make the trip south for the joint operations of the fleets.—*The Aerial Age Weekly*, Oct. 18, 1920.

ENGINEERING

ECONOMICAL METHOD OF UTILIZING TIDAL FORCE.—G. Bigourdan suggests a method of utilizing the force of the tides by means of a sort of fixed bell, with the open end downwards, and so arranged as to be gradually filled by the morning tide.

The air located in the bell would thus be compressed, resulting in a force which could be used direct or for raising other water and so creating a useful head. As the tide falls air would be sucked into the bell, and thus suction could also be used for raising water to a head.

This indirect means would permit of transporting and utilizing the force of the tides over a certain distance, vertical or horizontal. It has three advantages as compared with the usual direct and intermittent means: (1) it reduces to a minimum the parts exposed to the destructive action of the sea; (2) it permits the use of natural reservoirs, lakes or ponds, situated at various levels, and which would only require the minimum of expenditure for upkeep; and (3) it obviates the great inconvenience of the intermittent and periodic inequality of the tides. (*Comptes Rendus de l'Académie des Sciences*, July 26, 1920.—*The Technical Review*, Sept. 28, 1920.

A HIGH-SPEED INTERNAL-COMBUSTION ENGINE.—H. R. Ricardo, in a paper before the Gas Explosion Section of the British association, as reported in *Engineering*, gave the results of an extended series of tests on a high-speed engine with varying compressions.

A series of the tests dealt with the efficiencies at various loads and with different compression ratios. The results appear in the table. It will be observed that the efficiency at full load was higher with the higher compression ratio; of additional interest are the tests at partial loads, where the efficiencies at the higher compressions show a smaller drop than when using lower compressions.

RESULTS OF THE TESTS

Per cent of full load	Indicated thermal efficiency	Brake thermal efficiency	Relative efficiency
	Compression ratio 6 : 1		
Per cent	Per cent	Per cent	Per cent
100	34.9	30.7	68.2
80	33.	27.5	64.5
60	31.0	25.6	60.6
50	30.0	23.9	58.6
40	....	21.5	....
	Compression ratio 4 : 1		
100	27.5	23.4	64.6
80	25.8	21.7	60.6
60	23.5	19.0	55.3
50	22.3	17.4	52.4
40	....	15.2	....

Experiments with different fuels proved, as might have been expected, that each fuel had a certain limiting and very defined compression, after which detonation occurred, followed by preignition and loss of power. In certain oils no detonation occurred; violent preignition and an excessive drop in speed were the first indications that the compression had been carried too high. In all the ordinary fuels preignition never occurred until the engine had passed through the detonation phase.

The general conclusions arrived at may be summed up as follows:

1. The limiting compression is controlled by the tendency to detonate, which in turn is governed by the normal rate of burning. If means are employed for slowing down the normal rate of burning, such as the addition of a small quantity of CO_2, much higher compression ratios can be employed. Preignition which controls and limits the compression ratio, is in nearly every case brought about by some local use of temperature due to persistent detonation.

2. For any given fuel the tendency to detonate depends, apart from the compression ratio, upon the form of combustion chamber, the number and position of the igniters, the inlet temperature of the mixture, the strength of the mixture and the degree of turbulence.—*Power*, Oct. 9, 1920.

TESTING WELDS.—The question of testing welds is one that has been considered more or less since welding was known, but especially during the last five years. Its importance has now become very great. There have been many failures in the past, many of them not having been explained and some of them having been very expensive. As in all other developments, welding first received its principal impetus from the practical man. Of late, however, the tendency has been to investigate more carefully and more fully and by means not available to the ordinary welder. This means that scientists of all kinds have been called into consultation and that almost

every conceivable method of test has been suggested in order to determine what methods and materials would make the best welds from a standpoint of security, service and cost.

The welding of steel is frequently considered as not being especially difficult, and it is also sometimes considered that steel is steel and that no different treatment is required in the case of different qualities and varieties of steel. This idea is much less common to-day than it was several years ago, but it is still too prevalent for the good of the art. It is not as well known as it should be that a comparatively small difference in the percentage of carbon in the material being welded makes a very great difference in the results of either a bend or tensile test. If the carbon is 0.12 per cent or less, the material is soft, ductile and yields readily to any strain that may be put on it. Such material is frequently used for tanks and, because of its ductility and comparative freedom from damage by heating, is admirably suited for welding. Structural steel, bar steel and boiler plate contain about 0.15 per cent to 0.25 per cent carbon and have a tensile strength of about 60,000 pounds, while the soft low-carbon material has only about 52,000 to 55,000. Ship plate is required to have a tensile strength of from 58,000 to 68,000 pounds and in the heavier sections requires as high as 0.30 per cent carbon. It has been found by experience that the higher the carbon, the more difficult it is to get a satisfactory weld and the more danger there is of injuring the metal being welded. It is also evident that a weld made with a given welding rod or electrode can have only a given strength. If this strength is greater than that of the material being welded, the tests piece will always break outside of the weld. If, on the other hand, the weld is weaker than the material being welded, the rupture will always take place in the weld. An oxyacetylene weld made with ordinary low-carbon welding wire will have a tensile strength of about 52,000 pounds. This is stronger than soft tank steel and weaker than the other materials mentioned. It is possible to get with alloy steel rods of proper composition a tensile strength in an oxyacetylene weld of about 50,000 pounds. Neither of these materials will weld boiler steel, boiler plate or ship plate, so that the rupture will occur outside the weld when the section of the weld is the same as the section of the piece, and in making tests of welded pieces, it is necessary to know accurately the character of the material being welded.

The method of test to be applied in any given case depends largely on the use to which the welded piece is to be put. If it is to be used in a pressure vessel, I believe that not only should a tensile test be made, but that an alternating-stress test should be used because of the breathing of the tank due to changes of pressure. This latter test should also be applied where the weld is subjected to bending strain. There are no standards at present for weld tests, but it is advisable, wherever possible, to follow those of the A. S. T. M.

The best test, in my opinion, to determine quickly the general character of a weld, is to grind it off level with the surface of the pieces and clamp it on an anvil, with the center of the weld level with the top of the anvil, the bottom of the "V" toward the anvil so that the top of the weld is stretched when the projecting end is struck with a sledge. The blow should not be too heavy, and the number of blows and angle to which the piece bends before cracking are quite a good index of the value of the weld. It is true in this test, as in the tensile tests, that the quality of the material being welded has a great influence on the results. Stiff material throws more of the strain into the weld, while self ductile material will itself take considerable of the bend. In the case of defective welds—that is, those not fused along the "V" or which contain slag or other inclusions—this test will at once develop the defects. If a welded piece were to be used in a place where it might become red hot such as, for instance, in a locomo-

tive fire-box crown sheet, it would be entirely proper to test the welds at a good red heat by clamping them in a heavy vise or on an anvil with the center of the weld about half an inch from the edge of the vise or above the face of the anvil, heating them to a bright orange with the torch and then bending them as before as with a sledge.

If such welds are made in ½ x 2-inch bar steel, a 90-degree single "V" being used, and they bend to a right angle cold without cracking on the outside, a welder may feel well satisfied with his work.

TESTING RAILS FOR HIDDEN DEFECTS.—There has recently been developed a method for testing rails for hidden defects which was devised by A. M. Waring. It consists of deeply etching a polished surface of the material under test. For instance, a section of a weld might be cut out with a hack-saw machined or filed to a true surface, and polished on various grades of emery paper, ending up with 00 Manning. It is then placed in a warm solution of 25 per cent hydrochloric acid and water for from one-half to an hour. The acid will eat away the defects, making the edges of the material at them taper, so that rather large grooves and pits will be visible where the defects prior to the etching would be only microscopic. The etching test I consider to be of the greatest value in ordinary shop practice where it is desired to find out rapidly and quite accurately the quality of the work done by the different welders.

These rough tests, while satisfactory for determining the general quality of the work, do not answer as a basis for design, and more refined tests must be used as before referred to. I believe that the most important of these are the tensile and alternating-stress tests. The tensile test can be made in any shop provided with the usual tensile testing machine. The alternating-stress test is not as yet standardized even for unwelded material. I am inclined to believe that the machine devised by the Quasi-Arc Company is of considerable value, although it does not give absolute results; that is, it does not give the amount of fiber stress to which the piece is subjected.

A great deal may be learned from the appearance of a weld. It is difficult to describe the appearance of good welds, but after they have been seen a number of times an inspector can readily say whether the operator knows what he is doing. In gas welding, I would not accept a ripple weld in heavy material nor one which was narrower than about 2½ times the thickness of the sheet, because I have never seen a weld having these appearances that was properly made. The appearance in a gas weld of porosities on top indicates that the metal has been overheated, and the same thing is true in an electric weld. Inasmuch as I believe that the serious defects in welds are caused by oxides, it would appear wise in the case of gas welding to use no larger top than is necessary to produce thorough fusion. This means that the catalog speeds of welding are impossible if good welds are desired. The same thing is true of electric welds. The reason is that at the high temperatures of the steel caused by too large a tip or too heavy a current, the metal becomes overheated, and in that condition combines more readily with the oxygen of the air or with any excess oxygen in the torch flame, and produces oxides which are readily dissolved by the melted metal. As the metal cools down, these oxides are rejected in large part and pass to the grain boundaries, as do other impurities, so that it is perfectly natural that material that has been seriously overheated should be more brittle and weaker than the material that has been properly melted. In conclusion, I have found in a number of cases that very great improvements in the quality of the work were made by using regularly the bending test already described and by carefully instructing the welders until they were able to make welds that would meet this test with unfailing regularity.—*Power*, Nov. 2, 1920.

NAVIGATION AND RADIO.

ACOUSTICAL METHOD OF TAKING SOUNDINGS.—Sig. Marti describes the possibility of taking approximate soundings by means of a small charge of explosive immersed under water alongside a ship in motion.

A microphone, also immersed and connected up with the ship, registers the sound of the explosion and its echo due to the reflection from the bed of the sea. The interval of time between the original sound and the echo enables the depth to be computed. It is necessary to take into account the speed of the ship and of the variations in the velocity of sound due to temperature. The temperature correction introduces some uncertainty which can be neglected for small depths but not for greater depths. As, however, the horizontal distribution of temperature is generally uniform over considerable areas in deep water, a few measurements made with the ordinary sounding apparatus would be sufficient to give the temperature correction for a number of soundings taken by the acoustic method. A writer, commenting on the method, states that, while it is not new, the experiments described by the author represent its first practical application, which seem to give good results.

The acoustic method of sounding would probably be very useful for hydrographic surveys such, *e. g.*, as are necessary to determine the course of a submarine cable. (*Bolletino dell' Istituto Oceanografico; Rivista Marittima*, April, 1920.—*The Technical Review*, Sept. 28, 1920.

MAKING SHIPS FOG-PROOF.—As a practical guide to fog-blinded ships, which literally leads them to their berths in New York Harbor, the navy's new radio cable along the Ambrose Channel probably marks a new era in navigation; certainly in its first public demonstration, so soon after its actual laying was completed, it had passed far beyond the experimental, and our readers will be interested in the account of the demonstration on another page of this issue.

In minimizing hazard, insuring quicker docking, and effecting financial economics in operation, the radio cable fill a long-existent need. That navy enterprise can quickly extend these facilities to other ports seems assured, and adequate Congressional aid should be given freely toward this achievement. At the ports of Savannah, Charleston, Jacksonville and New Orleans fogs have caused expensive delays, and at times serious accidents. The radio cable, judged by the demonstration in New York, will make arriving ships accident-proof. And the advantages of American ownership of the advice for possible wartime emergencies should be an added source of pride.—*The Nautical Gazette*, Oct. 16, 1920.

RADIO CONTROL OF NAVAL UNITS.—Down through the long history of naval warfare and particularly during the last fifty years of it, successive inventions have been hailed upon their appearance as being "revolutionary." Armor plate, the rapid-firing rifled gun, the torpedo, the torpedo boat, the submarine and now the airplane, have been quoted as destined to turn everything naval upside-down, and lead overnight to the scrapping of the existing instruments of battle and the substitution in their place of the new wonder. In varying degrees, but in infinitely less measure than was predicted, the successive inventions have modified the art, or rather the instruments, of naval warfare; but not once have they revolutionized it. The student of naval history will find that these predictions have come mainly and almost exclusively from the pen of the layman. Rarely is it that the professional mind leaps to extravagant and over-hasty conclusions of this kind. Occasionally it does, and for proof of it we have only to bear in mind the recent pronouncements of Admirals Sir Percy Scott and Lord Fisher.

Just now we are beginning to hear about the great possibilities of distant radio control of naval weapons which hitherto have required direct manual

control. Experimental work carried on during the war proved that such control is possible, under favorable conditions, to an extent which before the war would have been scouted as quite impossible. Thus, it was shown that an airplane could be loaded with high explosives, sent up into the air without any pilot aboard, and directed by means of a new radio-control system installed on a pilot machine. It was proved that this controlled machine with its high explosive charge could be flown in the desired direction and made to strike unerringly any desired objective.

In other experimental work, carried out, like that to which we have just referred, under government auspices, it was proved that a torpedo may be steered into contact with its objective by means of radial impulses sent from an observing pilot plane flying overhead. Doubtless in the recent bombing of the old battleship *Indiana,* use was made, if not of the same electrical appliances, at least of the same general principle. In this case, the *Indiana,* without a single man aboard, steaming at ten knots was steered through radio control from the U. S. S. *Ohio,* which maintained a distance of about 5 miles from the moving target.

It is too early to predict to what extent radio control can be substituted for manual control in aiming and firing the tremendous weapons which modern invention has placed at our disposal. If, for instance, the course of a torpedo can be controlled from an airplane and further experimental work fulfils the promise that is contained in this new method, we shall come nearer to revolutionary changes than ever before. This efficiency under war conditions, however, has yet to be proved.—*The Scientific American,* Oct. 30, 1920.

RADIO MANEUVERS WARSHIPS.—Experiments just completed by the United States Navy prove that 12,000-and 13,000-ton battleships can be successfully maneuvered by radio from land stations operating directly upon the steering gear at a distance of from four to five miles. Reports of these tests, which were conducted off the Virginia Capes with the battleships *Ohio* and *Iowa,* have been received by Rear Admiral Griffin, chief of the Bureau of Steam Engineering. The experiments will, it is stated, revolutionize all future sea flights, as they prove that unmanned ships loaded with high explosives and fire ships can be directed with unerring accuracy against an enemy fleet.—*Aerial Age Weekly,* Oct. 30, 1920.

THE CORONA VOLTMETER.—An improved form of corona voltmeter is described for voltages of 150,000 volts. The instrument enables the corona to be used as a natural standard of high voltage, and its use has indicated an interesting modification in the law of corona formation.

The voltage at which the corona appears on a clean round rod is found to be constant to within one-tenth to one-quarter per cent. The law connecting the critical or corona-forming voltage gradient E in kilovolts per cm. at the surface of a wire of r cm. radius and the relative density δ of the gas may be stated in the form—

$$E/\delta = A + B/\sqrt{(\delta r)},$$

and when the constants A and B are determined, the voltmeter has a calibration depending only on its dimensions, and so constitutes a natural secondary standard of voltage. The determination of these constants involves the accurate measurement of the crest value of the voltage at which the corona appears, the ascertaining of the corona voltage to as small a difference of voltage as possible, and the measurement of δ. The main body of the article is concerned with the methods devised to make these measurements.

Whereas it was found that E/δ and $1/\sqrt{(\delta r)}$ are connected by a linear relation, in accordance with the formula above, for small rods and low pressures, yet for large rods and high pressures a departure from the straight line appeared. This is explained by the difference in the values of A and B that exist for the positive and negative corona. This is taken

account of by noting that for values of $1/\sqrt{(\delta r)}$ below 2.295, the negative corona appears first, and $A = 29.87$, $B = 9.918$. On the other hand, for values of $1/\sqrt{(\delta r)}$ above 2.295, the positive corona appears first, and $A = 33.03$, $B = 8.541$.

In the above the value of δ is given by $3.92\ p/(273 + t)$, where p is the absolute pressure in cm. of mercury, and t the temperature in degrees Centigrade. A new corona voltmeter is under construction that will have a range up to 400,000 volts. (J. B. Whitehead and T. Isshiki, *American Institute of Electrical Engineers, Journal,* May, 1920.)—*The Technical Review,* Oct. 19, 1920.

NAVY IMPROVES AIR TRANSMITTER EQUIPMENT.—Capt. George W. Steele, Jr., U. S. N., commanding the Air Detachment, U. S. Atlantic fleet, has reported to the Navy Department that the transmitting equipment installed on navy aircraft recently modified to operate on the new standardized wave length, has proved entirely successful under tests. The installation of distant control for ignition system has practically eliminated all ignition noises, both on the trailing antenna for receiving and on the radio compass coil. This reduction of ignition noises permits inter-communication between aircraft in flight for distances up to 10 miles. With the ordinary installation such communication is practically prohibited except when flying in comparatively close formation.—*The Aerial Age Weekly,* Oct. 30, 1920.

MISCELLANEOUS

THE "SUPER-DESTROYER."—The flotilla leader, which is a super-destroyer, is a new type of vessel developed during the recent war. These vessels are used to lead flotillas of destroyers into action. Being larger than destroyers they carry the essential facilities for a flotilla commander. They are better equipped for signaling and range-finding, carry a heavier battery, and a much more efficient radio equipment than a destroyer. They proved themselves to be very useful in the late war, and are now generally recognized as being required by modern organization for destroyer operations. Also, these larger vessels were found necessary for screening battle-cruisers, where the ability to maintain high speed in a seaway is a prime necessity.

The foregoing admirable summary of the functions of the flotilla leader is contained in the recommendations made by the General Board of the United States Navy for the building program of 1921. Five vessels of this type were included in the Board's program, which, however, has not been accepted by Congress, with the result that, for the next few years the United States Navy will have to do without a type of fighting ship which is possessed and highly prized by the other navies of the world. The flotilla leader is really an old type revived under a new name. It is the modern descendant of the "divisional torpedo-boat" and the "torpedo-gunboat" built during the closing decades of the 19th century, types which, in their turn, had sprung from the sea-going torpedo-boat and eventually became merged in the destroyer. The credit of having invented the flotilla leader must go to Germany, who some forty-five years ago ordered the *Zieten,* a fast "torpedo aviso," from the Thames Ironworks of London. Although but 975 tons in displacement and barely 200 feet in length, she had a speed of 16 knots, remarkable for those days, and carried a powerful armament of four 4.7-inch breech-loading guns, with submerged tubes at bow and stern for ejecting the "fish" torpedo. The success of the *Zieten* led others powers to experiment with vessels of this type, from which there grew a very numerous family. It was only in Germany, however, that the original function of the *Zieten* as a leader of torpedo boats was kept steadily in view, though lack of funds prevented that country from perpetuating the type.

In 1906 tactical maneuvers held in the North Sea convinced the British Admiralty that the system of using destroyers in large flotillas of twelve

to twenty boats necessitated the building of special leaders, or flag boats, from which the commodore in command could control his flotilla just as an admiral handles a squadron or fleet of battleships from his flagship. Since the ordinary destroyer did not offer sufficient bridge room, living accommodations, and other facilities for the commodore and his staff, it was considered necessary to design a vessel of larger dimensions, fitted up as a miniature flagship, and possessing superior qualities of speed and armament. The pioneer vessel of this type was the *Swift*, ordered from Cammell-Lairds of Birkenhead, in 1906. She displaced 1825 tons, was 353 feet in length and 34½ feet broad, and was equipped with turbine machinery of 30,000 shaft horsepower to produce the then phenomenal speed of 35 knots, which was at least five knots more than the best British destroyer of the period could make. The trials of this vessel, which was launched in 1907, were watched with keen interest, as few engineers believed she would ever make her contract speed. But the first runs over the measured mile confounded the skeptics, for the best run at full power gave a maximum velocity of 38.3 knots—a world's record which remained unbroken for ten years. Her boilers were exclusively oil-fired, and the success of this innovation encouraged the British Admiralty to embody the liquid fuel system in their later destroyers. But this drawback to the *Swift* was her inordinate cost—£280,500 ($1,402,500 at normal rate of exchange). For this sum three destroyers of ordinary type could be built, and consequently no further leaders were built until 1913, in which year the *Marksman* and *Lightfoot* were laid down. The *Swift* performed most valuable service during the war, and her dashing exploit in April, 1917, when, in company with the *Broke*, she fell upon six German destroyers in the Dover Strait and routed them with heavy loss, will long be remembered. Shortly before that action her original armament of four 4-inch rapid-fire guns had been changed to one 6-inch and two 4-inch, so that she was a most formidable opponent for any destroyer. Various structural modifications have now brought her displacement up to 2207 tons, but she is still good for 35 knots.

The value of the flotilla leader is evidenced by the fact that during the war period every naval belligerent, with exception of the United States, built many vessels of this type. Great Britain added no less than 34 of them to her fleet; Germany laid down flotilla leaders of unprecedented size and power; and both Italy and Japan evolved some very striking designs. The new French naval program includes six 2000-ton leaders, and the U. S. Navy Department is known to have prepared plans for vessels of the same type, though their construction has still to be authorized.

The accompanying table shows at a glance the principal features of representative flotilla leaders built, building, and projected for the world's navies.

TYPICAL FLOTILLA LEADERS OF THE LEADING NAVIES AT A GLANCE

	British		*German*	*Japanese*	*Italian*	
	GRENVILLE	WALLACE	V-116	AKIKAZE	AQUILA	LEONE
Number of boats in class	6	12	12	5	4	4
Year of launch	1916	1918	1917	1921	1916	1920
Length over all, feet	325	329	360	350	315	360
Beam, feet	31¾	31¾	36	34	31	34
Displacement, tons	1,666	1,740	2,400	1,900	1,600	2,200
Shaft horse-power	36,000	40,000	55,000	50,000	44,000	42,000
Speed, knots	34	36	35	38	34	34
Fuel capacity, (oil) tons	500	550	700	600	260	400
Armament: guns	4—4 in. R. F.	5—4.7 in. R. F.	4—5.9 in. R. F.	4 (or 5) 5—5 in. R. F.	3—6 in. R. F.	8—4.7 in. R. F.
Torpedo tubes	4—21 in.	6—21 in.	4—23.6 in.	6—21 in.	4—18 in.	6—18 in.

It will be seen from the accompanying list that the German flotilla leaders easily surpassed their contemporaries in size and weight of armament. These twelve boats—*S-113-115, V-116-118, G-119-121, B-122-124*—were designed to form an "Iron Division," primarily for the purpose of defending the "Heligoland Bight" against British raiders and mine-layers. They are of peculiar interest, illustrating as they do the radical change induced in the German conception of destroyer functions as the result of war experience. Before the war German naval officers attached minor importance to the gun armament of their torpedo craft. Logically enough, they insisted that the torpedo was the only weapon that counted in this type, and that every ton of available weight must be devoted to speed and torpedo tubes. It was not until a whole series of their boats had been sunk or badly mauled by the heavier gunfire of British destroyers that they departed from this rigid principle. All the German pre-war boats mounted 3.4-inch 22-pounder guns, which were soon replaced by the 4.1-inch 38-pounder with a semi-automatic breech-lock, enabling a very high rate of fire to be maintained. Guns of this caliber were supplied to nearly all the boats built during the war, and proved superior in range and smashing power to the British 4-inch. But it cannot be said that the German destroyers ever took kindly to artillery duels, and to the end of the war they never used their guns to full advantage.

What the big super-leaders of the *V-116* class might have done can only be surmised, for none of them was commissioned in time to take an active part in the war. A great mystery has been made in Germany about these twelve boats and the details of them given in the above list have not previously been published. Five boats were completed in the spring of 1918 and ran their trials in the Baltic. Most of them exceeded the designed speed of 35 knots, but the great weight of armament and the immensely powerful machinery proved too much for the scantlings, and all five had to go into dockyard for extensive alterations, which were still incomplete at the date of the armistice. The four 5.9-inch guns were on high-angle mounts and could be used either for flat trajectory fire or against aircraft. The projectile weighed 101 pounds and contained an exceptionally powerful bursting charge, which would have proved most effective against such comparatively flimsy targets as destroyers. The torpedo armament was limited to four tubes, mounted in pairs amidships, but these fired the new 23.6-inch torpedo, which is the most powerful weapon of its kind in existence. Its warhead is charged with 616 pounds of T. N. T.—practically double the quantity of explosive carried in pre-war torperdoes—and it can travel a distance of 16,350 yards at a velocity of 28 knots. Since it would be impossible to manipulate torpedoes and tubes of this size by hand, the *V-116* and her sister boats had special motors for loading and training the tubes. They were also fitted with the latest appliances for controlling guns, including director aiming and firing mechanism. It is, however, doubtful whether all this cumbersome and intricate gear was suitable for vessels which were simply enlarged destroyers, and therefore exposed to the sort of rough and tumble fighting in which headlong dash counts for more than science. Moreover, experience in other navies shows that the 5.9-inch gun, with its 101-pound projectile, is much too heavy to be conveniently manhandled on the slippery decks of a boat which is moving all ways at once. In theory, the German *V-116* leaders ought to have made short work of any destroyers they were likely to meet in the North Sea; in practice they would probably have been beaten by the smaller British boats armed with the handy 4-inch and 4.7-inch gun.

A particularly formidable type of flotilla leader is represented by the five new Japanese boats of the *Akikaze* class, building under the estimates for the current year. They will displace 1900 tons and have a speed of 38 knots. Four, or possible five, 5.5-inch 82-pounder rapid-fire guns will be mounted on the centerline, and all six torpedo tubes can be trained on either beam. A feature of these boats is their large fuel capacity.

which is expected to give them a cruising radius of 3500 sea miles at economical speed.

It will be seen that the modern flotilla leader approximates to the light cruiser in dimensions and armament. If the recent rate of progress is to be maintained, "boat" will soon become a misnomer, and we shall revert to the "torpedo cruiser" of thirty years ago, though on a much larger scale. In the destroyer and flotilla leader, as in every other type of fighting craft, each new demand for increased armament, speed and sea endurance involves a corresponding increase in size, and there is practically no limit except in the paying power of the nations concerned. But in every class of fighting ship there comes a stage of development which fulfils all reasonable requirements, and beyond which it is unnecessary to go. In the case of the flotilla leader this stage appears to have been reached in the smaller designs set forth in the table shown. War experience has demonstrated the all-round tactical efficiency of such vessels as the British Scott class, which, on the relatively modest displacement of 1740 tons, combine in a high degree the essential qualities of a destroyer flagship. It is of interest to learn that a tentative design prepared at Washington last year provided for a vessel of 1800 to 1900 tons, of 37 knots speed, armed with four 5-inch rapid-fire guns and eight torpedo tubes.—*The Scientific American,* Nov. 6, 1920.

MEDITERRANEAN NAVIES.—The situation in regard to the powers who have naval forces in the Mediterranean is at the present time one of particular interest. In no theater was the outcome of the recent war more dramatic and far-reaching. As regards our own navy, one immediate effect of the armistice was the despatch to the Mediterranean of a squadron of modern battleships, thus restoring a force which we were obliged to withdraw in 1912 owing to the growing menace of the German fleet in the North Sea. In addition to the six *Iron Dukes* there has also been sent to the Mediterranean a light cruiser squadron and a destroyer flotilla, both composed of ships passed into service during the war and a number of attendant vessels, including an aircraft carrier. The Admiralty have stated that this moderately strong force is, in their opinion, necessary to meet political conditions in the Near East. That it is not excessive is shown by the fact that it has been necessary this year to detach a squadron from the main, or Atlantic fleet to the Levant, the Mediterranean fleet being fully employed on other important duties and unable to meet all the demands made upon it. The presence of the battleships under Vice-Admiral Fremantle has given rise to a belief in certain quarters that the Mediterranean is to be regarded in future as one of the principal training grounds of the main fleet, but there is no foundation whatever for this assumption.

Compared with the feverish activity in naval development which was taking place in 1914, the present position is very tranquil. Urged on by her German Allies, Austria had made good progress with her division of four dreadnoughts of which two were in commission. Italy had been obliged to put in hand seven ships of this class, of which three were completed. Against these two partners in the Triple Alliance, France had put afloat thirteen vessels of the dreadnought era, of which eight were complete. The concentration of the whole of the French battleship strength in the Mediterranean, which had the effect of making our Ally superior to the combined fleets of the other two powers, aroused hostile criticism, no less than our own evacuation of those waters and concentration in the North Sea. But the policy in both cases was amply justified by the war. even though, thanks to the commendable attitude of Italy, the situation for the Entente was much better than it might have been. Among the minor naval powers the chief was Turkey, which in addition to her four old battleships and seven small cruisers was having two dreadnoughts built in England; this expansion policy being reflected in Greece, which as an addition

to her armored cruiser and three small battleships, had ordered a battle-cruiser, the *Salamis,* in Germany.

All this has been changed by the war. Austria has disappeared from the list of first-class naval powers, and so far as competition between France and Italy goes, it is a race to reduce their naval commitments rather than otherwise. The Turkish fleet, moreover, has ceased to exist, and Bulgaria is forbidden to develope her forces in the Black Sea. The French Navy thus indisputably holds the first position with 11 modern battleships to the five of Italy. As regards the future, in neither country has a definite program been adopted any more than in Great Britain. Our own action in cancelling the contracts for the *Howe, Anson* and *Rodney* has been followed by the French abandoning the construction of the five vessels of the *Bearn* type, which were in a more advanced state, and certain of which are to be used as hulks, and by the Italians stopping all work upon the four ships of the *Caracciolo* type. The only direction in which French naval construction is showing any activity is light cruisers. There is as yet no sign that in either country has naval opinion settled on a new battleship type. It will be interesting to see whether the reported intention of Spain to proceed with the building of three 25,000-ton battleships has any influence in inducing the larger powers to follow suit.—*The Army and Navy Gazette,* Oct., 16, 1920.

RAPID TRIMMING OF SUBMARINES BETWEEN TWO STRATA OF WATER.—In considering the possibility of keeping a submarine between two layers of water of different temperature—and, consequently, different density—it is necessary to consider the two factors which must remain the same, viz.: the volume of the submerged submarine and the weight of the water displaced.

To trim the vessel under the circumstances stated above, it is necessary to ascertain its actual volume by deducing the reduction of volume caused by the increased pressure from experiments made during its trials, thus avoiding the dangers due to allowing too small or too great a volume.

The article proceeds to consider the effect of the variation of the temperature of the sea-water—which is stated to be of little importance so far as the volume of the hull is concerned—that of changes in the density of sea-water, and of calm or rough sea effects.

The density of sea-water changes for several reasons, including increase of pressure, the quantity salts in solution, and temperature. The compensating tank of a submarine requires to be not less than 2 per cent of the displacement when in surface trim. Change of buoyancy due to temperature must always be considered if it is desired to effect rapid trimming of the submarine. This can be obtained by measuring the temperature of the sea at different depths by means of a thermometer inserted through the side of the conning-tower, the vessel being maneuvered in depth until a zone of water is reached where the changes of temperature are not very sudden. By making allowance for the variation of temperature when the sea is calm or has recently been so, it is possible so to trim a submarine that she floats with the periscope scarcely showing above water, as if she remained suspended by the periscope. Withdrawing the periscope she can remain at the particular depth totally submerged, but without diving. (Lieut. Eugenio Normand, Royal Italian Navy (Submarine Section); *Shipbuilding and Shipping Record,* June 3, 1920.)—*The Technical Review,* Oct. 19, 1920.

SECRET SIGNALLING BY INFRA-RED RAYS.—During the war, considerable use was made by the French Navy and Army of a system of lamp signalling in which secrecy was assured by the use of in visible infra-red rays. The signals were detected by the action of the rays on sulphate of zinc which becomes phosphorescent on the application of the rays in certain circumstances.

The source of the rays can be an incandescent lamp in a suitable projector provided with a dark screen which cut off all visible rays. The receiving apparatus is provided with a concentrating mirror and a clockwork device which causes a travelling band coated with the sensitive compound to pass through the focus. The compound is excited by exposure to blue rays obtained from a suitably screened lamp inside the apparatus. The system was used over considerable distances. Another application of the same principle was for detecting the passage of ships across a channel at night. An infra-red beam is directed horizontally across the stretch of water to be watched, and this normally produces a continuous trace in the receiving apparatus except when interrupted by the passage of a vessel when a dark interval is produced. Another method of reception is by means of a delicate thermo-pile and galvanometer. (*L'Ouvrier Moderne,* May, 1920.)—*The Technical Review,* Sept. 28, 1920.

SELENIUM AND SOME OF ITS USES.— Selenium (See, atomic weight 79 2) is most frequently found in the form of selenides of other metals—lead, silver or copper.

Two forms are usually recognized:—(1) Amorphous, (2) vitreous. Commercial selenium is generally vitreous, in small rods of very dark green color. The metallic modification, obtained by heating and annealing the vitreous selenium, is the form most used for electrical applications. The vitreous material is melted and moulded into the required shape, and the temperature allowed to fall to about 210° C., where it is maintained for a few hours, before being allowed to cool slowly to atmospheric temperature. This process has an important effect upon the electrical properties of the material, which in its initial state is practically an insulator, but after annealing becomes a conductor, whose initial resistance depends largely on the annealing process. Its peculiar characteristic is the variation of this resistance with the light falling upon it. As it is now grey and nearly opaque it should be arranged for use in a very thin film.

Amongst its applications one of the first tried was to photometry, but as selenium is variously sensitive to light of different colors the results obtained were inaccurate. The selenium cell has been used in wireless telegraphy and telephony, being connected in series with a battery and telephone receiver, and exposed to light emitted by a searchlight as transmitter, which light can be focussed on to the cell through a lens. Multiplex signalling can be carried on by using color filters, and even the invisible rays of the spectrum can be used. Another application is to the optophone, which enables the blind to read type by sound, the light reflected by or passing through perforations in each letter on to the selenium cells producing a characteristic sound in a telephone receiver. The same instrument can be adapted for locating and recognizing objects in a room.

Selenium is also used for the telegraphic transmission of pictures. It has also given interesting results in the photography of sound waves; by reversing the process of its production a phographic film of such a sound wave may be used to reproduce sound or speech, and it is suggested that the sounds of actors' voices, etc., might in this way be added to the cinema film. (P. R. Coursey, *Wireless World,* May 29, 1920.)—*The Technical Review,* Oct. 19, 1920.

CURRENT NAVAL AND PROFESSIONAL PAPERS*

The War Plans Division, War Department General Staff. *The Journal of the U. S. Artillery.* October, 1920.

Projectiles. *The Journal of the U. S. Artillery.* October, 1920.

Optical Glass and its Future as an American Industry. *The Journal of the Franklin Institute,* October, 1920.

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*These articles are kept on file and will be loaned, upon application, to members.

Efficiency of Propulsion of Full-Sized Ships. *The Shipbuilder,* October, 1920.

The Aerial Cruiser (Description of British *R-80*). *The Scientific American,* Oct. 16, 1920.

A Pocket Machine gun (N. Y. Police Force Standard). *The Scientific American,* Oct. 16, 1920.

The Training of Engineering Students in Industrial Management. *Engineering and Industrial Management,* Oct. 14, 1920.

The Future of the Fabricated Ship. *Engineering,* Oct. 8, 1920.

South African Iron and Steel. *Engineering,* Oct. 8, 1920.

The Present Position of Aircraft Research and Contemplated Developments (abstract appears in notes above). *Engineering,* Oct. 15, 1920, *et. seq.*

Dreadnoughts and Dollars. *Sea Power,* November, 1920.

NOTES ON INTERNATIONAL AFFAIRS

FROM OCTOBER 10 TO NOVEMBER 10

PREPARED BY

PROFESSOR ALLAN WESTCOTT, U. S. Naval Academy

POLAND AND RUSSIA

POLISH TROOPS OCCUPY VILNA.—Subsequent to the armistice between Poland and Lithuania, Polish forces under general Zellgouski on October 9 seized and occupied the city of Vilna, the ancient Lithuanian capital. General Zellgouski then announced the existence of a new state of "Central

THE BOUNDARY BETWEEN POLAND AND RUSSIA AGREED UPON AT THE RIGA PEACE CONFERENCE IS INDICATED APPROXIMATELY BY THE DOTTED LINE RUNNING FROM DRISSA SOUTHWARD TO THE RUMANIAN BORDER.

—From November *Times Current History*.

Lithuania," proposed boundary negotiations with the Lithuanian Government at Kovno, and called on Poland for aid and recognition.

This action, analogous to that of d'Annunzio in Fiume, and taken without the open approval of the Polish Government, called forth remonstrances from the western powers. A joint Franco-British note on October 18 summoned Poland to disavow responsibility in the affair. The difficulty was afterward turned over for solution to the commission appointed by the League of Nations which was already on the scene as mediators between Poland and Lithuania. Both these states agreed to continue negotiations under the auspices of the League. On October 28 the League Council meeting at Brussels decided that the territorial dispute between Poland and Lithuania should be settled by a plebiscite.

POLISH-RUSSIAN TREATY RATIFIED.—On October 25 the All-Russian Soviet voted to ratify the preliminary peace treaty between Poland and Russia. Foreign Minister Tchitcherin pointed out that Poland agreed to refuse assistance to Wrangel's forces in South Russia and to deny all other aid to reactionary elements in Russia. This he declared was sufficient to justify the territorial concessions made to the Polish Government

As shown by the accompanying map, the new Russo Polish frontier lies considerably to the eastward of that proposed by the Allied powers, and leaves Soviet Russia with no territory bordering on either Germany or Lithuania.

POLES OBJECT TO DANZIG CONVENTION.—On October 23 the Polish delegates, appearing before the Council of Ambassadors in Paris, presented objections to the Danzig Convention on the ground that it did not give Poland free access to the sea and control of customs, as specified in the Treaty of Versailles. The convention establishes a commission composed half of Poles and half of residents of Danzig, under a neutral chairman, to control the port. The Poles prefer to buy land and develop their own port facilities.

SOVIET NOTE ON SUBMARINES UNSATISFACTORY.—London, November 3.—Replying to the Russian Soviet Government's recent note concerning the operation of submarines by the Soviet Navy, Earl Curzon of Kedleston, Secretary for Foreign Affairs, says the British Government's belief in the proposed aggressive action of the submarines was based on a Soviet Minister's statement when the submarines were launched in the Black Sea that he hoped they would sink Entente vessels.

The British Government, Earl Curzon added, did not feel justified in running any risk, and now had found its fears confirmed by the vague statement of the Soviet note, which would permit of Soviet submarine torpedoing a British ship under the excuse of mistaken identity.

The note asserts that the Soviet forces in the Black Sea are still engaged in acts of open hostility against British interests, and it demands definite assurances.—*N. Y. Times,* April 11, 1920.

LLOYD GEORGE ON BOLSHEVISM.—At the Lord Mayor's Banquet in London on November 9, Premier Lloyd George spoke of the Russian problem as follows: "Bolshevism is a passing phase that cannot survive. It is such an

impossible creed, it is such a ludicrous creed, it is such a crazy creed, it cannot survive but I tell you what may survive—anarchy.

"Bolshevism will pass away. If Russia falls into the hands of anarchy it may be a generation before it is redeemed. It is a dead loss to Europe. It is worse—it is a festering thing which will poison the atmosphere of the world.

"Therefore, in spite of everything, we persevered to try and secure peace. I know the difficulties—thwarted by suspicions on all hands in Russia, in Europe, in Britain; divided purpose in Russia, divided purpose in Europe, and, above all—there is no use pretending—we have been dealing with men who, unfortunately, did not realize how important it is that they should respect their own obligations. In spite of all that we mean to persevere, because we realize the danger of a Russia sunken and sodden in anarchy."

LEAGUE OF NATIONS

MEETING OF LEAGUE ASSEMBLY AT GENEVA.—During the first weeks of November preparations for the first meeting of the League of Nations Assembly at Geneva on November 15 were well under way and delegates were arriving. It was reported that Germany, Austria, and Bulgaria would apply for admission to the League. A program of business to be taken up by the Assembly consisted of 29 items, including election of president, nomination of committees, consideration of amendments to the covenant, consideration of the tribunal plan proposed by the committee at The Hague, and admission of new members to the League.

LEAGUE COUNCIL AT BRUSSELS.—Brussels, October 28 (Associated Press).—The Council of the League of Nations this morning closed its sessions in Brussels. The Council took a final adjournment after referring the question of Danzig, the regulations concerning which are in dispute between Poland and the authorities of the free city, to the Assembly of the League, which is to meet at Geneva next month.

The Council took other important action in deciding upon a plebiscite as to the disposition of the territory in dispute between Poland and Lithuania, this including the line fixed by the Supreme Council in December, 1919.

A. J. Balfour, the British representative, in making the closing address declared that four great powers not now members of the League would enter it shortly.

"Without these great powers," he added, "It is impossible to predict what the League may accomplish."

FRANCE AND GREAT BRITAIN PUBLISH AGREEMENTS.—At the Brussels meeting of the League Council, Great Britain submitted for registration and publication 16 international agreements made with foreign powers or self-governing commonwealths within the British Empire since January 10 last. This action was in compliance with Article XVIII of the League Covenant providing that "no treaty or international engagement shall be binding until registered." The documents included the Anglo-French oil agreement, a commercial agreement with Esthonia, and the contract with Soviet Russia relating to prisoners.

France announced on November 1 that the military treaty between France and Belgium would also be placed on file with the League secretary and published.

OBJECTIONS TO CECIL AS SOUTH AFRICAN DELEGATE.—Prior to the session of the League Assembly at Geneva, Premier Smuts of South Africa named Lord Robert Cecil as one of the two members of the South African delegation. To this nomination France made a formal protest on the ground that delegates from British self-governing commonwealths should be citizens and presidents of those commonwealths and not Englishmen, in order that England should not control six votes in the assembly.

LEAGUE COUNCIL ADOPTS WORLD COURT PLAN.—On October 26 the League Council approved the plan for a permanent court of international justice as proposed by The Hague Committee of Jurists, with the exception of the provision for obligatory jurisdiction and certain other minor matters. The plan for the choice of the judges, and other provisions attributed to Mr. Elihu Root, were adopted in their entirety.

The proposal for compulsory jurisdiction provided that the court should have jurisdiction in any case in which one party in the case appealed to it. To this Norway and Denmark raised objections on the ground that it went further than the League of Nations Covenant itself. They proposed instead that the court should have jurisdiction only in cases in which both parties made appeal.

ALLIED AGREEMENT ON REPARATIONS PLAN

Paris, November 6.—The dispute between the British and French Governments as to whether the Reparations Commission or Allied Premiers shall fix the amount of German reparations has been settled by a compromise, by the terms of which the Reparations Commission shall fix the amount and the Premiers will look it over before it becomes final. Lord Derby, the British Ambassador, took to the Quai d'Orsay late to-day a note from London containing Lloyd George's latest ideas and the French will reply to-night. I gather that the following four steps will be taken.

(1) There will be a conference between allied experts named by the Reparations Commission and German experts which will study the technical aspects of the problem and report to their government. (2) This will be followed by a conference between representatives of the Allied Governments and the German Government, who will consider reparations and report to their governments. (3) The Commission on Reparations to which the Allied Governments will have communicated their views on the results of the two conferences will fix the German debt to the Allies. (4) The chiefs of the Allied Governments will then meet "to make the necessary decisions," including the fixing of guarantees.

It will thus be seen that there is little likelihood of the amount of reparations being fixed before next May by which time, according to the terms of the treaty, the total must be presented to Germany.

Paris, November 6 (Associated Press).—Coolness between the British and French Governments over their divergent views relative to German reparations was dissipated by a note from the British Government delivered at the French Foreign Office personally by the Earl of Derby last night.

It is said at the French Foreign Office that France now approves, not only of a Brussels Conference of Allied and German experts, but also an advisory meeting at Geneva of allied representatives, which she formerly opposed. There is a possibility that Germans will participate in this meeting.

It is understood that the Geneva meeting, whether attended by the Allied Premiers or not, will draw up a basis for action by the Reparations Com-

mission. The decision of the Commission, according to this understanding, will then be submitted to a conference of the Premiers for final action.
It is considered probable, it was added, that the German Minister of Finance will attend the Geneva meeting.—*N. Y. Times,* July 11, 1920.

ENGLAND NOT TO CONFISCATE GERMAN PROPERTY.—At the close of October Great Britain renounced the right of confiscating further German property in the United Kingdom, in case Germany should default in payment of reparations. This action was regarded as a measure for the encouragement of trade between England and Germany, assuring Germans against possible loss of property and goods in British hands.

This action was at variance with the policy of France, where confiscation has already in part been carried out. German property in the United States has been largely converted into liquid assets and is now awaiting the disposition of Congress.

NEAR EAST

ALLIED AGREEMENT ON TURKEY.—On November 4 Great Britain, France, and Italy made public an agreement reached among these three powers regarding their respective spheres of influence in the former Turkish Empire. This agreement, though not announced at the time, was reached on August 10, the date of the signing of the Turkish treaty.

The compact assigns spheres of influence, control of railroads, etc., in Asia Minor, and pledges the three powers to give each other diplomatic support in maintaining their positions in "the areas in which their special interests are recognized." France's concessons lie in eastern Asia Minor, Italy's in the southern part of that region. Great Britain's privileges are not stated, but it is understood that she will be given the presidency of the commission controlling the Dardanelles.

DEATH OF KING ALEXANDER OF GREECE.—King Alexander of Greece died on October 25 from the effects of a bite inflicted by a pet monkey. On October 28, Prince Paul, the 19 year old younger brother of Alexander, was proclaimed king, and Admiral P. Coundouriotis was elected regent until the arrival of the new king.

The offer of the throne to Paul was made on the condition that King Constantine and his eldest son Prince George would formally renounce their rights. In his reply to the offer Prince Paul declared that he could not disregard the rights of his father and elder brother, and that his action would be controlled by the will of the Greek people as expressed in the approaching elections.

These elections, postponed till November 14, were a definite conflict between the Venizelos and the Constantine factions in Greece.

FIUME DISCUSSION RENEWED.—Rapallo, Italy, November 9.—The question of Fiume was brought up for discussion to-day by the conference of Italian and Jugoslav delegates being held here for a settlement of the Adriatic problem, although no agreement has yet been reached on the proposal of the Italian delegates that the Istrian frontier be that established

by the Treaty of London. The Italian delegates proposed that the independence of the new State of Fiume be recognized by both countries, but the Serbian delegates, especially Anton Trumbitch, the Jugoslav Foreign Minister, strongly opposed independence for Fiume. They maintained that the port was indispensable to Serbia for economic and commercial reasons, declaring it be their only safe and fit outlet to the sea.—*N. Y. Times*, November 9, 1920.

MEXICO AND LATIN AMERICA

RECOGNITION OF OBREGON GOVERNMENT.—In a formal statement issued on October 29, Secretary of State Colby made public a letter from Roberto V. Pesquera, confidential agent of the Mexican Government, requesting recognition of the present government of Mexico and resumption of official relations with the United States. In his statement Secretary Colby expressed the opinion that Pesquera's letter "offers a basis upon which the preliminaries to recognition can confidently proceed," that the new government of Mexico "had given indication of stability, sincerity, and a creditable sensitiveness to its duties," and that "the last cloud upon the ancient friendship of the two peoples is soon to disappear."

The chief point of conflict between the two governments is the retroactive feature of Article XXVII of the Constitution of 1917, concerning oil and mineral deposits, which foreign interests in Mexico regard as equivalent to confiscation of their property. It is understood that the present Mexican Government will meet the American objections on this point.

BENTON CLAIMS ADJUSTED.—The claims of the British Government resulting from the murder of William S. Benton, a British subject in Mexico, were adjusted by an agreement between the Mexican and the British Governments made public on November 4. By its terms Mexico will pay 20,000 pesos to Benton's widow, who is a Mexican subject, and a pension during her widowhood of 5 pesos a day.

ZAYAS PRESIDENT OF CUBA.—Early returns from the Cuban election of November 2 indicated the victory of Dr. Alfredo Zayas, Coalition candidate for president, over General Jose Gomez, his Liberal opponent.

SECRETARY COLBY ON SOUTH AMERICAN TOUR.—It was announced by President Wilson on November 9 that Secretary of State Bainbridge Colby would visit Brazil, Uruguay and other South American countries to return visits to the United States made by officials of those countries. The date of Secretary Colby's departure was set for the latter part of November.

JAPAN AND UNITED STATES

TREATY NEGOTIATIONS PROGRESSING.—Washington, Nov. 3.—The Japanese situation will not become tense as the result of the adoption of the referendum in California on the alien land ownership directed against the large Japanese colony in that state. It was learned upon high authority to-day that the State Department had anticipated the vote in California

by reaching a tentative agreement with the Japanese Ambassador as to what action should be taken to satisfy the residents of California.

It is understood that Japan is not unwilling to enact a law prohibiting Japanese immigration to the United States, and that in return for this the Japanese now in California will receive full civil and property rights. Such an agreement has been arrived at, it is understood, but, of course, has to be accepted by the Japanese Government before it becomes operative as well as by the United States Senate. It is understood that if Japan agrees to this solution a treaty will be sent to the Senate which will cover this and other matters in dispute.

It is believed that the stage has been reached where both in Washington and in Tokio tentative drafts of the proposed new treaty and of the modified gentlemen's agreement are being prepared, and it is possible that the present situation will continue for some weeks while the two parties are reaching an agreement upon the exact phraseology.—*N. Y. Times,* Nov. 4.

JAPANESE NAVAL APPROPRIATIONS.—In recent debates on the budget in the Japanese parliament sharp attacks were made upon the enlarged naval program, on the ground that these "colossal estimates for armaments" were aimed especially against the United States. To this Premier Hara replied:

As you are aware, Japan is now among the five great powers of the world, and it is important for her to be provided with armaments commensurate with her position in world politics. I feel sure that the present national defense program will excite no misunderstandings abroad, and that Japan will not be credited with any ambitious designs.—*November Times Current History.*

ANGLO-JAPANESE ALLIANCE.—Washington, Nov. 4.—In diplomatic circles the view was expressed to-day that the defeat of the League of Nations clause in the American elections would have a profound reaction on foreign chancelleries, and that one result would probably be to remove any doubt in respect to the renewal of the Anglo-Japanese alliance.

Baron Hayachi, the new Japanese Ambassador in London, already had stated that there had been no disposition in either England or Japan to adopt any other course than the renewal of the alliance, for which he thought, there was more need now than ever.

The subject of the alliance has been informally discussed by British authorities with American officials and it is believed that changes in the terms of the alliance will reflect England's desire to have nothing in the treaty that might possibly create suspicion in the United States, and Japan's willingness that nothing in it might be construed to threaten this country.—*N. Y. Times,* November 3.

REVIEW OF BOOKS

"Escuela Del Buque," Por Juan Rivera, Teniente De Navió De La Marina Cubana.

This book, which was compiled primarily for the use of officers of the Cuban Navy, consists principally of extracts from "The School of the Ship," by Rear Admiral A. W. Grant, U. S. Navy, with numerous amplifications.

It should prove of interest to the naval officers of all Spanish speaking nations, as it is interesting, instructive and comprehensive.

The forces influencing a ship with one propeller are considered in detail in a chapter written by Captain D. Carlos Suanzes of the Spanish Navy. This is followed by a description of the forces affecting a ship with twin propellers. Then follows a chapter describing the various methods of obtaining tactical data.

The handling of ships in formation is taken principally from U. S. Naval Academy Seamanship Department Notes. Formations in relation to gunfire are considered in detail, with illustrations from modern fleet maneuvers and recent naval battles.

Various methods of scouting and searching are taken up, with free quotations from a book by Commander W. S. Pye, U. S. Navy.

For the greater part "Escuela del Buque," as its name implies, deals with handling ship; and the subject is covered thoroughly.

Naval officers interested in the study of Spanish will find "Escuela del Buque" interesting and profitable reading.

M. M.

"A History of Sea Power." By William Oliver Stevens and Allan Westcott. (New York: George H. Doran Company.)

Considered as a narrative only, this book is excellent in a high degree. It is interesting from the first page to the last, full of incidents of many kinds, clear in statement and description, and replete with historical information of an important kind. No other book contains in so small a space so much information about the rise of sea power, and no other book shows that rise so plainly and progressively.

The book starts with "The Beginnings of Navies" as the title and subject of its first chapter, and presents an interesting picture of the vessels and fleets of the Mediterranean, both naval and commercial, that sailed that wonderful inland sea, when "an Egyptian king, some 2000 years before Christ, possessed a fleet of 400 ships." It then discusses the rise of Crete and the Cretan fleets, and the extraordinary civilization they developed. It takes up the Phœnician merchants and navigators next, and shows how they not only transported the products of west Asian manufac-

turers westward over the Mediterranean and brought back metals and other raw materials, but how they spread the west Asian civilization all over the Mediterranean and even beyond its farthest gate. The rise of Carthage, a colony of Phœnicia, naturally followed; and soon came her attainment of the position of the most affluent and powerful state in all that ancient sea, which then was the center of the maritime activity of the world. Assyria then appears upon the scene, and subjugates Phœnicia and controls her fleets. Assyria and Babylon later falling before Persia, Phœnicia became a dependency of Persia, and helped her conquer Egypt. Next came the Athenians, who developed so fine a navy that they defeated the Persians at Salamis, and made possible the unhindered development of Greek culture. Rome came next; and then came bitter wars, called Punic Wars, between her and great Carthage, that finally laid Carthage literally in the dust, and made Rome the mistress of the sea.

After the fall of the Western Roman Empire in 476 B. C., the Eastern Empire, with its capital at Constantinople, stood as the sole bulwark against all the anti-civilization forces of the world for nearly a thousand years, until taken by the Ottoman Turks in 1453. This feat she could not possibly have performed without the possession of paramount sea power, which in turn could not have been paramount without the secret of Greek fire. Then arose the naval and commercial fleets of Venice, that long withstood the Turk, and finally vanquished him at the battle of Lepanto in 1571.

Nearly a century before, Columbus had discovered America. Then Vasco da Gama circumnavigated Africa, and then Magellan's ship, the *Victory*, circumnavigated the entire world. The large sailing ship was soon developed, and with it many appliances of navigation. The Portuguese, Spanish, Dutch and English then entered into a bitter competition for sea mastery, the Portuguese and Spanish going down first and then the Dutch, leaving Great Britain the mistress of the ocean. France arose to dispute the title: the conflict lasted for more than a century, but it was finally settled in favor of the English by Nelson's victory at Trafalgar on October 21, 1815.

The book makes an attractive sketch of the rise of the American mercant marine and navy, and the subsequent rise of the German and Japanese. The rivalry for world power that characterized the closing years of the 19th century and the opening of the 20th, culminating in the World War in 1914, is interestingly described in Chapter XV, which includes the Spanish American War and the Russian Japanese War. The rest of the book, nearly one-third, is a brief naval history of the World War.

In dealing with the book as a narrative, one must give unstinted praise; but when dealing with the lessons which it draws from history and inculcates, one finds himself shaking his head at times, and at times rising from his chair in indignation. For the authors, instead of confining themselves to their avowed rôle of historians in which they are proficient, not only assume the rôle of strategists, but confidently condemn other strategists, like Jellicoe. Their strictures on Jellicoe concern his conduct at the battle of Jutland, where Jellicoe was and they were not; where Jellicoe knew

more of the information on which he had to act than they do now; where Jellicoe found himself equipped with an experience and a training in naval warfare greater than that possessed by the authors of this book, and therefore a greater competency to decide the questions which were presented to him there than they possess. Had Jellicoe acquitted himself as poorly as the authors of this book presume, England would have said so as clearly as she did to Byng and Calder and many another admiral, who failed to "do his utmost." But, while Jellicoe's failure actually to destroy the enemy was bitterly bemoaned by the British public, and while they realized all the advantages of the enemy's destruction which the authors of this book point out, they realized also that, *under the conditions as they were presented to him,* Jellicoe did exactly right. Jellicoe had not been entrusted with the charge of Britain's whole security in order that he might get a laurel wreath like Nelson's, or even in order that he might do some "stunt" to glorify the British Navy. He was given that charge in order that he might protect Great Britain. This he did.

It is a misfortune which the army and navy labor under, that nearly every one, after learning a few phrases such as "damn the torpedo!" "the spirit of Nelson"; the "writings of Mahan"; "Concentration"; "Keep your powder dry," etc., feels adequately equipped for discussing the most intricate questions of strategy, involving the most esoteric points. In this book, this tendency is shown at its maximum in the discussion of the battle of Jutland; but it prevails throughout. We are told in the Preface, for instance, that "the tendency of our modern era of mechanical development has been to forget the value of history," and are thence led through a narrative which is extremely interesting (largely of actual battles) but which makes only the most casual allusion to the most significant single truth in all the history of sea-power, the enormous importance of "mechanical development." This truth is minimized amazingly; and while the importance of powerful guns is tacitly admitted, the whole subject of accuracy is almost ignored. It is true that one sentence says that "reforms in naval gunnery urged by Admiral Sir Percy Scott (a British officer) were taken up"; but no reference whatever is made to the fact that these reforms were rendered possible by the invention of an American naval officer, which was adopted by the U. S. Navy *ten years* ahead of any other navy. Yet it can hardly be denied that it was the accuracy and consequent effectiveness attained by using that invention which led the navies to make the great increase in size of guns which has followed, the consequent great increase in size of ships, and the consequent great increase in the power of sea-power.

A failure to realize adequately in other ways what our country has done for sea-power seems manifest. One instance is an omission, almost complete, of recognition of Admiral Sims's work in getting effective co-operation between the United States and the Allies in the recent war. Another instance is a wholly inadequate appreciation of the unprecedented and brilliant character of Admiral Plunkett's work in France.

Considered strictly as a history, which is all it purports to be, the book is admirable.

B. A. F.

NOTICE

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It is now in its forty-seventh year of existence. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers upon subjects of interest to the naval profession, as well as by personal support.

On the subject of membership the Constitution reads as follows:

ARTICLE VII

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fees to the Secretary and Treasurer. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control. To be declared elected, they must receive the affirmative vote of three-quarters of the members represented at regular or stated meetings, either in person or by proxy.

Sec. 5. Associate members shall be elected from Officers of the Army, Revenue Cutter Service, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: "Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control. The Board of Control will at each regular meeting ballot on the nominations submitted for election, and nominees receiving a majority of the votes of the board membership shall be considered elected to membership in the United States Naval Institute."

Sec. 8. The annual dues for regular and associate members shall be three dollars, all of which shall be for a year's subscription to the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, payable upon joining the Institute, and upon the first day of each succeeding January. The fee for life membership shall be forty dollars, but if any regular or associate member has paid his dues for the year in which he wishes to be transferred to life membership, or has paid his dues for any future year or years, the amount so paid shall be deducted from the fee for life membership.

Sec. 10. Members in arrears more than three years may, at the discretion of the Board of Control, be dropped for non-payment of dues. Membership continues until a member has been dismissed, dropped, or his resignation in writing has been received.

ARTICLE X

Sec. 2. One copy of the PROCEEDINGS, when published, shall be furnished to each regular and associate member (in return for dues paid), to each life member (in return for life membership fee paid), to honorary members, to each corresponding society of the Institute, and to such libraries and periodicals as may be determined upon by the Board of Control.

The PROCEEDINGS are published monthly; subscription for non-members, $3.50; enlisted men, U. S. Navy, $3.00. Single copies, by purchase, 50 cents.

All letters should be addressed U. S. Naval Institute, Annapolis, Md., and all checks, drafts, and money orders should be made payable to the same.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ARTICLE, 1921

A prize of two hundred dollars, with a gold medal and a life-membership (unless the author is already a life member) in the Institute, is offered by the Naval Institute for the best original article on any subject pertaining to the naval profession published in the PROCEEDINGS during the current year. The prize will be in addition to the author's compensation paid upon publication of the article.

On the opposite page are given suggested topics. Articles are not limited to these topics and no additional weight will be given an article in awarding the prize because it is written on one of these suggested topics over one written on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. All original articles published in the PROCEEDINGS during 1920 shall be eligible for consideration for the prize.

2. No article received after October 1 will be available for publication in 1920. Articles received subsequent to October 1, if accepted, will be published as soon as practicable thereafter.

3. If, in the opinion of the Board of Control, the best article published during 1920 is not of sufficient merit to be awarded the prize, it may receive "Honorable Mention," or such other distinction as the Board may decide.

4. In case one or more articles receive "Honorable Mention," the writer thereof will receive a minimum prize of seventy-five dollars and a life-membership (unless the author is already a life member) in the Institute, the actual amounts of the awards to be decided by the Board of Control in each case.

5. The method adopted by the Board of Control in selecting the Prize Essay is as follows:

(a) Prior to the January meeting of the Board of Control each member will submit to the Secretary and Treasurer a list of the articles published during the year which, in the opinion of that member, are worthy of consideration for prize. From this a summarized list will be prepared giving titles, names of authors, and number of original lists on which each article appeared.

(b) At the January meeting of the Board of Control this summary will, by discussion, be narrowed down to a second list of not more than ten articles.

(c) Prior to the February meeting of the Board of Control, each member will submit his choice of five articles from the list of ten. These will be summarized as before.

(d) At the February meeting of the Board of Control this final summary will be considered. The Board will then decide by vote which articles shall finally be considered for prize and shall then proceed to determine the relative order of merit.

6. It is requested that all articles be submitted typewritten and in duplicate; articles submitted written in longhand and in single copy will, however, receive equal consideration.

7. In the event of the prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of the gold medal.

By direction of the Board of Control.

H. K. HEWITT,
Commander, U. S. N., Secretary and Treasurer.

TOPICS FOR ARTICLES

SUGGESTED BY REQUEST OF THE BOARD OF CONTROL

"Rebuilding the Navy's Enlisted Personnel, and Reestablishing Its Morale and Spirit After the Serious Slump Caused by too Rapid Demobilization and High Wages in Civil Life."
"The Human Element in the Administration of Discipline."
"A Demobilization Programme for the Future."
"The Mission of the Naval Academy in the Molding of Character."
"Health of Personnel in Relation to Morale."
"Physical Factors in Efficiency."
"The Naval Officer and the Civilian."
"Naval Bases, Their Location, Number and Equipment."
"Military Character."
"The Ability to Handle Men a Necessary Element in the Equipment of a Naval Officer."
"The Relation of Naval Communications to Naval Strategy."
"The Relation of Naval Communications to Naval Tactics."
"The Training of Communication Officers."
"The Organization of a Naval Communication Service."
"The Naval Policy of the United States."
"A Review of the Battle of Jutland with Lessons to be Learned Therefrom."
"Modification in the Design and Armament of Ships to Meet the New Conditions of Aerial and Subsurface Attack."
"Coordination of Surface, Subsurface and Aerial Craft in Naval Warfare."
"Our New Merchant Marine."
"Submarine Warfare, Its History and Possible Development."
"Escort and Defense of Oversea Military Expeditions."
"A Proposed Building Programme for the U. S. Navy, Including an Efficiency Air Service."
"Naval Organization from the Viewpoint of Liaison in Peace and War Between the Navy and the Nation."
"The Ship's Company—Its Training, Discipline and Contentment."
"The Principles of Leadership of Naval Personnel."
"Morale Building."
"The Value of Facility in Exposition—Verbal and Written—for Naval Officers."
"Discipline as Affected by the Human Relation."
"The Value of Pep."
"Navy Spirit—Its Value to the Service and to the Country."
"The Influence of the Term of Enlistment on the Efficiency of the Service."
"The Principles upon which Should be Founded the Freedom of Neutral Shipping on the High Seas."
"The Fighting Fleet of the Future."
"The Future of the Naval Officer's Profession."
"The Navy: Its Past, Present and Future."
"The Navy in Battle: Operations of Air, Surface and Underwater Craft."
"Shall I Remain in the Navy?"
"Psychology and Naval Efficiency."
"The Naval Policy of the United States in the Light of the Peace Treaty."
"Scope of Naval Industrial Activity and the Navy's Relation to Shore Industry."
"The Pacific Theater."
"Was Germany's Coast Impregnable?"
"Future Development of the Naval Shore Establishment."
"America as a Maritime Nation."
"Arguments for and against the Restriction of the Manufacure of Munitions to Government Owned Factories."
"The Present Rule of Neutrality regarding Contraband and Blockade—Is it Justifiable in Ethics or in Expediency?"
"The United States Navy and the League of Nations."
"Is a League of Nations *Navy* Desirable?"
"The Adaptability of Oil Engines to all Classes of War Vessels."
"The Place of Mines in Future Naval Warfare and the Rules under which Their Use Should be Allowed."
"The Use and Abuse of the Doctrine of Continuous Voyage."
"The Question of the Future Use of Submarines."

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Keds

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